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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

A MACHINE THAT EATS ITS WAY THROUGH THE HEAVIEST SNOWS—[See page 219]

Vol. CXXII. No. 9
February 28, 1920

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a year

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879

Distant submarine, as seen through the range-finder

When the Halves of the Conning-Tower Meet, Read the Range — and FIRE!

Do you know how our gunners find the range or distance of an enemy target—a submarine far off in gray wastes of sea, or an enemy post on a distant hillside? They train a "range-finder" on it, turn a screw till the halves of the image meet, and read the distance in yards or meters directly from a scale.

It is a matter of seconds only. Through deflection of light rays by a movable prism, the instrument measures angles and computes the distance, mechanically, accurately, instantly.

But distances are so great, and angles so infinitesimally small, that the slightest flaw in the glass, the slightest error in computation or formula, the tiniest deviation in edge or side of the many-angled prisms, will destroy the instrument's usefulness—turn a hit into a miss, perhaps victory to defeat.

That we were able in a great emergency to supply our Government not with the usual few score, as in former years, but literally with thousands of range-finders, and at no sacrifice of Bausch & Lomb scientific standards—

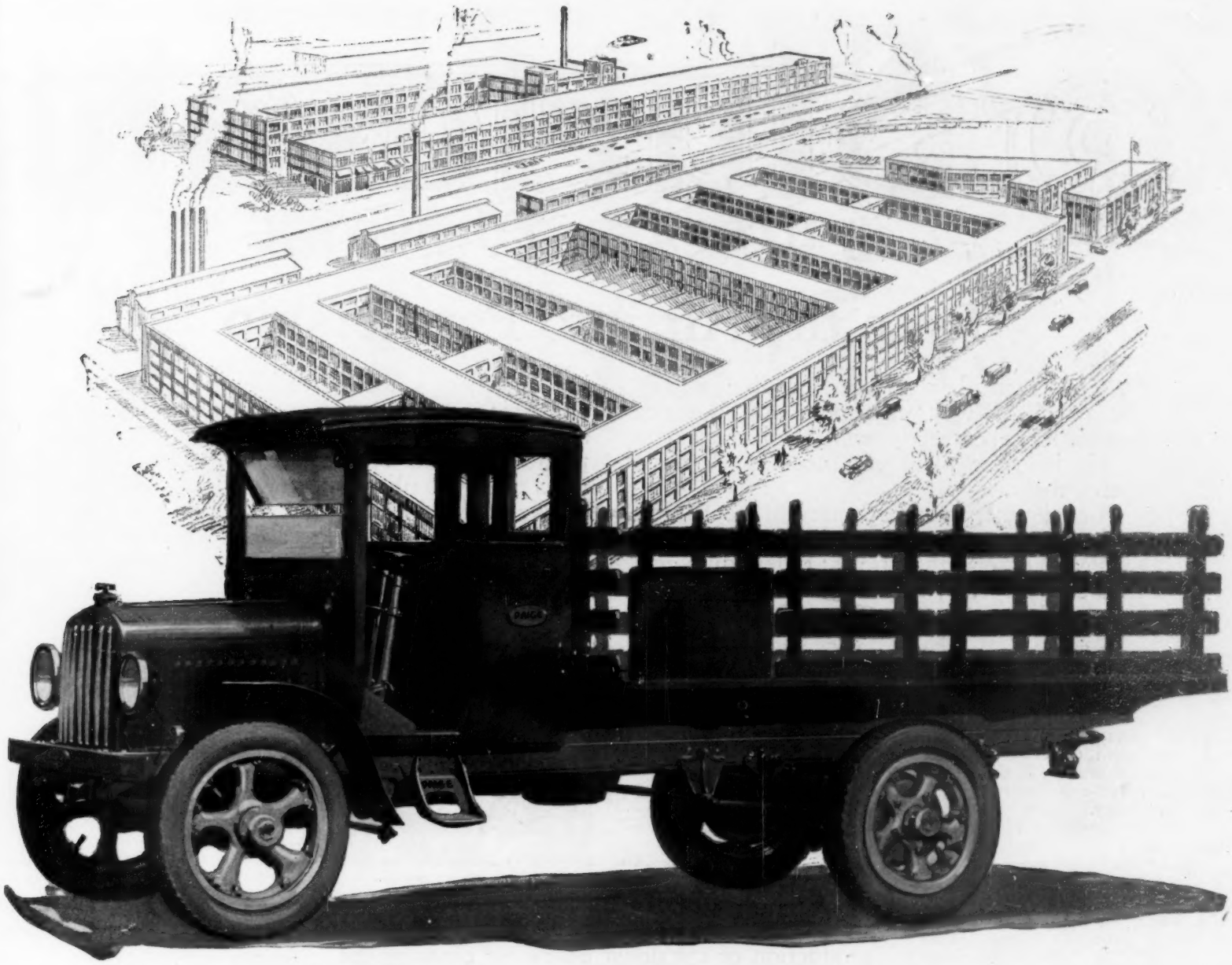
That even when working to a thousandth part of a millimeter we have been able to devise *machines* for large-scale production of range-finders, binoculars, gun-sights, aiming-circles, searchlight mirrors, periscopes—all the optical instruments of modern warfare—

This is both a source of pride to us, and a suggestion of our equipment for the improvement of optics generally.

Write for literature on any optical product in which you are interested.

BAUSCH & LOMB OPTICAL COMPANY . . . ROCHESTER, N. Y.

Makers of Eyeglass and Spectacle Lenses, Photographic Lenses, Microscopes, Balopticons, Binoculars, and Engineering and other Optical Instruments



A Truck and Its Traditions

There could be no more eloquent testimonial to the stamina of Paige trucks than their demonstrated ability to perform an unusually large quota of severe haulage tasks, day after day and week after week with scarcely a lay-up for either adjustment or repairs.

Performance of such dependable character is naturally a source of great satisfaction to us. For we measure our success as truck builders not so much by the larger number of Paige trucks in use as by the service which each individual truck renders to its owner and, through its owner, to the business world at large.

We prize very highly the respect in which the name Paige has been held during all of the ten years we have been building motor vehicles. And we shall continue to follow the policy of building into our products such honest excellence that they will always merit the public confidence reposed in them.

The pride which we take in our products gives you definite assurance that when you buy a Paige truck its performance will be of the same high character as that of the many other Paige trucks which have made good in actual service. The Paige nameplate is a guarantee on which you can always safely rely.

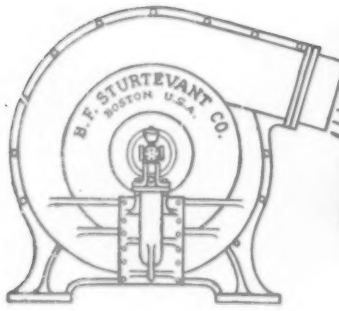
PAIGE-DETROIT MOTOR CAR COMPANY, DETROIT, *Michigan*

Manufacturers of Paige Motor Cars and Trucks

PAIGE

The Most Serviceable Truck in America

MOTOR TRUCKS



Sturtevant

REG. U.S. PAT. OFF.

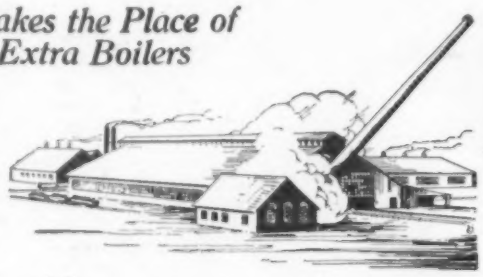
PUTS AIR TO WORK

Take the Air into Partnership

THE earth has an inexhaustible supply of air. Every movement of this air is power. The correctly controlled movement of air in your plant can accomplish some useful work.

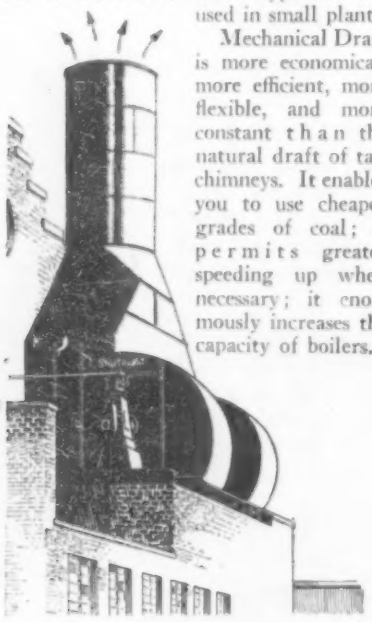
For instance, we make Sturtevant mechanical draft apparatus; machines that convey grain, wool, and other light articles; other equipment that conveys coal, sand, and heavy material. We install systems which heat or cool a building, factory or school, furnishing it with dry or moist air according to the exact conditions desired. Our ventilating systems speed up human production and our mechanical draft apparatus takes the place of extra boilers and high smoke-stacks. With our machinery, lumber is seasoned as well in weeks as it formerly took years to do. During sixty years of endeavor we have learned how to make air do more kinds of work than most manufacturers realize.

Mechanical Draft Takes the Place of Tall Chimneys and Extra Boilers



THIS picture shows the destruction of a tall smoke-stack. Sturtevant Mechanical Draft made this stack unnecessary.

There are two types of mechanical draft — Forced Draft, by which a fan forces the air up through the grate, and Induced Draft, by which air is drawn up from below. Turbo-Undergrate Blowers are of the Forced Draft type and are used in small plants.



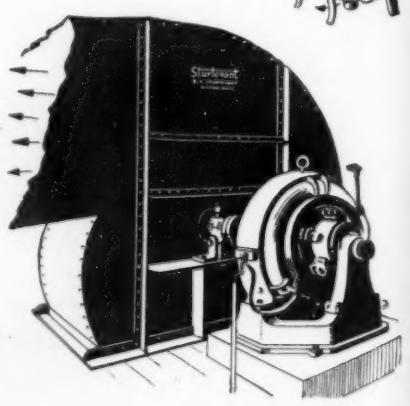
Mechanical Draft is more economical, more efficient, more flexible, and more constant than the natural draft of tall chimneys. It enables you to use cheaper grades of coal; it permits greater speeding up when necessary; it enormously increases the capacity of boilers.

How Air Affects the Box Office Receipts

THE law requires that a ventilating system be installed in all theatres that hold over a definite number of people.

But think of the state of affairs which would exist without adequate ventilation. People sit close together and exhale enough carbon dioxide to put one another to sleep.

Perhaps that last play, which nearly everyone speaks so well of, did not seem so wonderful to you because the theatre's ventilating system was not being operated the night you were a spectator.



THESE are only two uses of air. There is hardly an industry that could not speed up production or cut down operating costs by the right use of air.

You may have long considered putting air to work in your own plant. If you will write, telling us the nature of your business, we will let you know if there is a chance to profitably install our apparatus and will send you a bulletin prepared by our engineers, which describes our apparatus and its use in your particular business. If you specially request, one of our representatives will visit your plant and go over your problem with you. Remember, sixty years' experience is built into every Sturtevant product and is behind every Sturtevant recommendation. Address

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Hyde Park, Boston, Mass.

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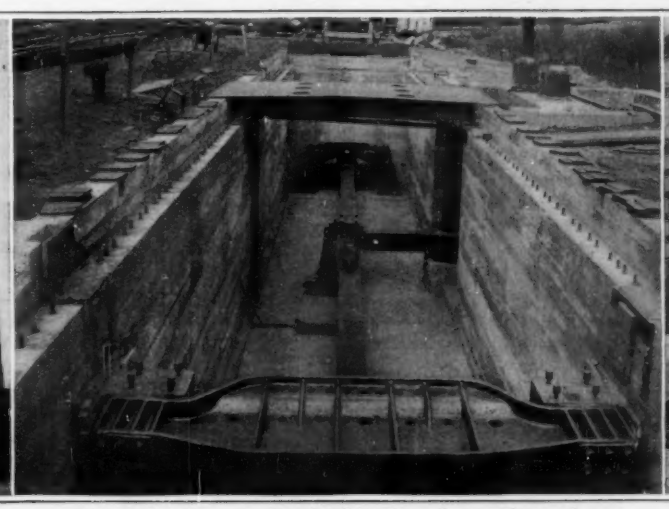
SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

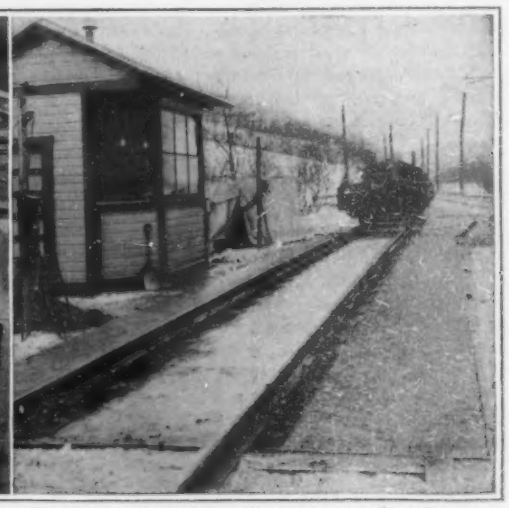
THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXII. NUMBER 9 | NEW YORK, FEBRUARY 28, 1920 | 10 CENTS A COPY $5.00 A YEAR

Lowering huge steel girder into place



View along the concrete pit of the huge locomotive scale



The locomotive scale as it appears to the trainmen

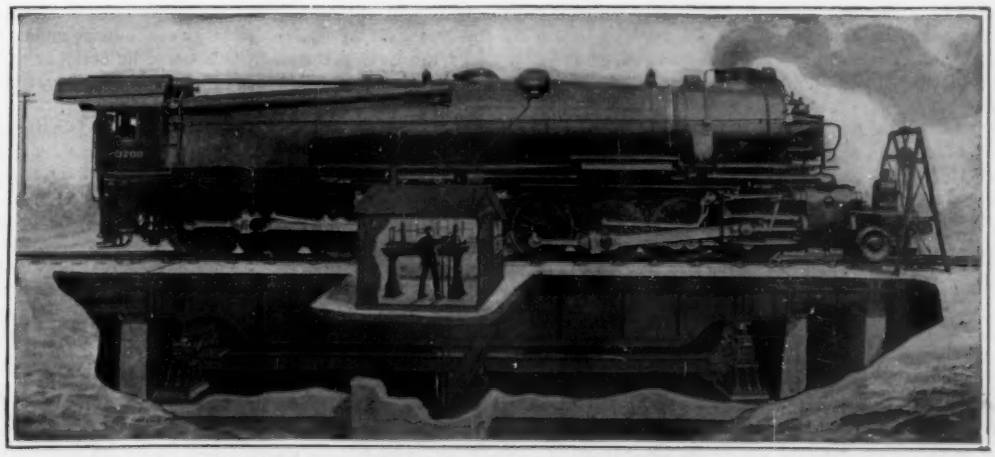
Weighing a Monster Locomotive

By Herbert T. Wade

TO determine the weight of such enormous locomotives as are the order of the day naturally requires weighing equipment on a correspondingly large scale. The weight of a locomotive not only is a fundamental item in its mechanical design and performance, but it must be considered in view of the capacity of the track and particularly the amount that can be carried safely by bridges. In the locomotive shops a number of separate scales usually placed under the different axles can be used together to weigh a locomotive, but the Pennsylvania, whose scale department is under the charge of Mr. A. W. Epright, has at least one track scale of high capacity on which even the largest locomotives may be weighed like other and lighter rolling stock. At the track scale at Harrisburg, Pa., the weight of one of the biggest locomotives was determined with precision without over-straining the scale or unusual difficulty, and this weight, over 600,000 pounds, was said to be the heaviest load which a track scale had ever been called upon to carry. This scale was a plate-fulcrum track scale of the standard type adopted for the Pennsylvania Railroad, and described at the time in the SCIENTIFIC AMERICAN of November 3, 1917. This is a scale not only of great strength and capacity, as well as high accuracy demonstrated in numerous tests and constant use, but also of the greatest simplicity, being of the two section type where the plate girder bridge carrying the tracks rests directly upon the scale sections of the lever system at either end. Here are four main levers arranged in pairs transverse to the track with a multiplication of 3½ to 1, whence the force is transferred to the longitudinal extension levers, with a multiplication of 20, uniting at the center and connecting with the transverse extension lever with a multiplication of 11 3/7, and to the butt of the weighing beam with a multiplication of 800, so that the weight of the movable piers supports the main load and is adaptable as desired.

In this scale the various sets of levers of the system, seven in number, are connected by thin bending or flexure plates of high grade chrome vanadium alloy steel which take the places of knife edge fulcrums in ordinary platform scales.

For this particular weighing, locomotive and tender together were too long for the scale bridge rail, so that the tender was uncoupled and locomotive alone was drawn on the track by another locomotive. First there was a mere passage across to see whether any weakness developed in the scale, for in the plate fulcrum scale there is no relieving gear or independent dead rail when weighing is not desired. This test was satisfactoy as here and in the subsequent operations there was no serious overstrain or deflection of the members of the scale mechanism. Then the large locomotive was carefully placed on the weighing rails, and as the pilot wheels extended over they were jacked up and chained to the frame, so that the two sets of drivers carried the entire load. This amounted to 610,000 pounds and it is interesting to note that the maximum change of balance in a test extending over several hours was 45 pounds which represented the difference in balance from the beginning to the end of the test, a period of several hours. The weighings were repeated in various forms on four different days as it was desired to determine the distributed weight of the locomotive on the individual axles. A previous notable weighing of a large locomotive was in 1916 at West Albany, N. Y., where a New York Central class 1300 locomotive, weighing with tender in full running order 518,240 pounds, was placed on a six-section Fairbanks scale.



Broken-away view of the huge track scale, showing how it weighs the largest of locomotives

A New Aviation Instrument

THE "RATE-OF-CLIMB METER," is the description applied to a device being evolved by the United States Bureau of Standards. Foreign to its designation, the invention is not an instrument to keep tab on your gas meter but is a device for recording the rate of ascension of an airplane or other altitude-climbing objects.

The tube or thermometer, technical description of which is being withheld until scientific tests have been completed, operates under the accepted theory that air pressure is gradually minimized the higher you mount in exploring the clouds. Measured by the time having elapsed for the air to leak from the tube-like meter, the pressure indicator tells the rate of speed attained by the airplane.

Reduced to the simplest terms, apply the use of the meter in travelling upward in an elevator of a sky-scraper building. Place a little liquid in the tube and the rate of its disappearance from one channel of the instrument to the other will indicate the rate of climb.

The measuring scale of the rate-of-climb meter is independent of altitude when the object is stationary. For instance, remove the Woolworth Building to a tall mountain and the instrument would operate under the same conditions as if the test was applied in New York City.—*By S. R. Winters.*

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, February 28, 1920
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Naval Critic

FUTURE histories of the Navy of the United States will contain no brighter pages than those which deal with our share in the Naval operations of the late war. Although, due to political causes, the war found our Navy unprepared, when once the political brake had been released and the inherent spirit of the Navy was permitted to express itself in action, the results were immediate and far-reaching.

It is not our intention to recapitulate the fine work that was accomplished—our achievement has been fully recorded in the pages of the SCIENTIFIC AMERICAN. What we do wish to emphasize is the fact that, if the technical officers of the Navy had been allowed to tell the public how unprepared was our Navy for war, that is to say, if our officers had not been muzzled from 1912 to 1917, our Navy would have been fully prepared when we entered the struggle. Consequently, the submarine war against merchant shipping would probably never have been started or would have been crushed at the very outset.

Those of us who know something of the interior workings of the Navy Department have been aware that, for the past nine years, there has been a deliberate attempt by the civilian side of the Department to crush out all criticism of naval matters so far as it was possible to do so. Criticism from the outside, the Secretary was unable to prevent. Criticism from the inside the Secretary has shut out by putting a padlock upon the lips of the officers of the Navy, and forbidding them to give any information whatsoever upon naval matters.

Having thus shut off from the public all possible means of learning the truth, good or bad, favorable or unfavorable, as the case might be, from the technical officers who alone know the facts, and who have no axe to grind, other than a sincere and patriotic endeavor to make the Navy just as good as it possibly can be, the Secretary reserved for himself the right to tell the people just how things were going with the Navy. He has maintained his own little press bureau conveniently to hand, and out of that bureau has come just the kind of exploitation literature which the Secretary's understanding of the meaning and proprieties of his high position happened to favor.

Anyone who has followed naval matters with any attention or intelligence must have perceived that the whole trend of Mr. Daniels's press matter and Mr. Daniels's public pronouncements, interviews, et cetera, lies in the direction of unqualified exploitation of his own naval administration. Throughout the whole of these utterances, one searches in vain for any admission of even partial failure, any suggestion that things might be better than they are, or might have been done better than they were.

And ever since, by a peremptory order, he sealed the lips of his officers, the public has been obliged to become a part of this mutual admiration society. If Mr. Daniels had his way, he would make the public drunk, so far as the Navy is concerned, with liberal draughts of "superlativitis,"—a brew in the making of which he is quite without a peer. That kind of thing may be very good politics, but it is very poor patriotism, if it should so happen, as well it may, that this gagging of the mouth of criticism is doing serious injury to the material and the morale of the Navy.

We all know what happened to Commander Stirling in the early days of Secretary Daniels's regime, when that officer stated that we did not possess a single submarine that was capable of successful diving and underwater maneuvering—which was a fact. We also know what was the sequel to the declaration of the President's own aide, Admiral Fiske, that our Navy was utterly unprepared for war, and that it would take five years to put it in a condition of all-round efficiency. It took courage on the part of these officers to say those things, knowing, as they must have known, the politically opportunistic turn of the Secretary's mind. They followed the path of duty, and they have paid the price. Since the Navy is not a political institution, we believe that the order enjoining upon the officers of the Navy complete silence to the public on technical matters should be countermanded.

But why, it may be asked, should the public be taken into the confidence of the Navy Department? By what right does it demand that it shall be free to learn about naval conditions from the lips of the men who design and the men who fight our ships, rather than from a civilian who is a political appointee, and may possibly be thinking more about the interests of his party than he is about those of the Navy?

The answer is twofold. In the first place, the Navy belongs to the taxpayer. It was his money that built it—his money it is that keeps the Navy going. In the second place, civilian criticism has frequently been most helpful and constructive. To cite a notable instance, we have but to refer to the proposed new battle-cruisers. Had they been built as designed, they would have been unfit to enter the line. It was outside lay criticism which led to the revision of the plans of these ships, with the result that when they are completed, they will be the most effective fighting ships afloat in any navy of the world.

Prospects of the Hudson Vehicular Tunnel

ACCORDING to a report made public by the New York Commission, in which is included a detailed report by Clifford M. Holland, Chief Engineer of the Joint Commission, the minimum time set for the completion of the Hudson River tunnel is three and a half years. The most sensational figure among those given is the estimate of the total cost of the tunnel, which is now set down as $28,669,000. The original figure, estimated on pre-war prices, was $12,000,000, and the wide difference is one more of the many evidences which daily confront us of the enormous increase in the cost of labor and materials. This increase, of course, is no fault of the Commission or its engineers, and there is some comfort to be derived from the fact that, at the end of the eleventh year from the date of opening, that is by 1924, the expense will be met by the tolls and that, if the same rate of tariff be continued for twenty years longer, or until 1944, each State will be reimbursed for the bond issues and there will be a surplus of $33,635,000, thus covering the expenditures and realizing a handsome profit even on the total outlay of over $28,000,000.

The above estimate of the ability of the tunnel to pay for itself is based on the fact that by charging the same rates as are charged by the ferries, the earnings would be $1,248,500 at the end of the first year of operation and that they would increase to $3,587,000 at the end of the fifteenth year, and that meanwhile the expenses would be reduced from $788,250 for the first year to $307,500 at the end of the fifteenth year. The growth of ferry traffic below Forty-second Street (the tunnel is to be at Canal Street), has been steady and rapid, having risen from 15,300 vehicles daily in 1913, to 17,300 vehicles daily in 1919, an increase of 13 per cent. This represents a total annual number of vehicles crossing below Forty-second Street of 5,202,000 in 1913, and 5,882,000 in 1919. The total number of vehicles transported across the Hudson River on all ferries is, at the present time, 7,684,000 per year. The study by the Commission of the probable growth of traffic as based upon the growth since 1913, shows that for the five ferries nearest to Canal Street, traffic will have increased from 3,774,000 vehicles in 1919 to 6,596,000 in 1924, and to 16,456,000 in 1934.

Now a study of the movement of traffic across the Hudson River gives reason to expect that in 1924 the tunnel will carry 5,610,000 vehicles, and that five years later, the traffic will amount to 8,800,000 vehicles. Another five years will see the total rise to 12,900,000 vehicles, and at the beginning of the fourth 5-year period, it will have risen to 17,800,000 vehicles. This, it must be understood, is an estimate of the trend of traffic which would naturally seek the tunnel. The tunnel's capacity, if it carried two lines of traffic in each direction varies from 13,270,000 vehicles to 15,800,000 vehicles. A one-way tunnel would have a capacity about equal to the traffic demand of 1924, but a two-way tunnel such as is to be built will have sufficient capacity to accommodate all traffic for a period of ten years from 1924, the date of opening the tunnel. To accommodate all traffic for a period of approximately twenty years would require a three-way tunnel.

The tunnel is being built jointly by the States of New York and New Jersey, with Mr. Holland as Chief Engineer, and a Board of Consulting Engineers including Col. William J. Wilgus, who built the Detroit River tunnels, Mr. J. Vipond Davies, who built the Pennsylvania tunnels, and other eminent engineers. The important problem of ventilation has been solved by providing two separate ducts, one to deliver fresh air into the tunnel roadway, and the other to exhaust the foul air. The ventilation plans have been decided upon after a most elaborate investigation, in which all possible sources of information have been tapped and a large amount of special experimental work has been done.

The tunnel will consist of a pair of twin cast-iron tubes with an external diameter of 29 feet, each to accommodate two lines of traffic in each direction upon a 20-foot roadway. The plans and method of building the tunnel will follow closely those adopted in building the existing tunnels below the Hudson River. A very valuable feature of the plans is that there will be a double approach to each tunnel, this with a view to avoiding congestion at the several exits and entrances. We consider that the question of street congestion is one which should, as in this case, receive most careful study whenever a new means of communication of magnitude such as this tunnel or the great bridges which span the East and Hudson Rivers is opened. It can readily be understood that the maximum capacity of such thoroughfares might be handicapped by the failure to open up easy avenues of approach to their terminal points, and the Commission are to be congratulated on having given this element of the problem their careful consideration.

What Tonnage Means

THE term "tonnage" in the shipping business has five meanings, according as it refers to deadweight, cargo, gross, net or displacement tonnage. Deadweight tonnage is the difference between the number of tons (of 2240 pounds) of water a vessel displaces "light" and the number of tons it displaces when submerged to the "load water line."

Cargo tonnage refers to either "weight" or "measurement." The weight ton in the United States and Great Britain is the English long ton of 2240 pounds. A measurement ton represents 40 cubic feet of space.

Gross tonnage refers to vessels and not to cargo. It is found by dividing the capacity of the vessels' closed-in spaces in cubic feet by 100. A vessel ton is 100 cubic feet.

Net tonnage is a vessel's gross tonnage less the space occupied by crew, engine room, bunkers, et cetera. In other words, it is the space available for passengers and cargo.

The displacement of a vessel is the absolute weight in long tons of the vessel and its contents. Its light displacement is its weight without stores, coal or cargo. Its loaded displacement is the weight of the vessel with cargo, fuel and stores.

The Shipping Board, upon whose definitions the above has been written, gives the following relative tonnage figures for a modern freight steamer: If a vessel has a net tonnage of 4,000, its gross tonnage will be 6,000, its deadweight carrying capacity, 10,000, and its loaded displacement, 13,350 tons.

Electricity

Swedish Telephones for Poland.—It is reported that several Swedish concerns are engaged in restoring and building additions to the telephone systems of Poland and Lithuania. Since the 1st of October last over 15,000 telephones have been installed by these Swedish companies in Warsaw alone.

New Uses for the X-Ray are described in a recent issue of the *Journal of Electricity*. The X-ray has been found very useful in the examination of timber up to 18 inches thick. Internal knots, resin pockets, cracks and grub holes can be easily detected—an invaluable aid in airplane construction. Another important use of the X-ray is in ascertaining the purity of insulating materials for electrical use. Small metallic specks in fiber or mica, for instance, can be detected instantly.

America's Telephone Industry.—According to the report about to be issued by the Bureau of the Census showing the results of the census of telephones covering the year 1917, there are 53,234 separate telephone systems and lines. These lines and systems operated 28,827,188 miles of wire in the United States—enough to girdle the earth at the Equator 1,153 times—and connected 11,716,520 telephones and 21,175 public exchanges. The messages or "talks" sent over these wires aggregated the stupendous total of nearly 22 billion, or, to be exact, 21,845,722,335. Figured on the estimated population of the country in 1917 this gives 211 messages per annum to every man, woman, and child. The industry in 1917 gave employment to 262,629 persons, of whom 171,119, or over 65 per cent were women.

Distant Electrical Controls for Military Searchlights.—It has been found by experience that an observer operating a military searchlight finds it difficult to train the searchlight on the target when he is stationed close to the searchlight itself. The reason for this is that the observer at the lamp is handicapped by the dazzling effect of the bright beams on the eye. On account of this feature of searchlight operation, remote-control schemes have been devised whereby the observer is stationed at a distance of some 500 feet from the searchlight itself and there trains the lamp upon the target by means of electrical control. Theodore Hall, writing in a recent issue of *General Electric Review*, describes a number of schemes, known as potentiometer schemes, in which the field of the operating motor is placed across a certain portion of the rheostat and by means of a dial switch the armature may be connected between the center point of the rheostat and points either to the right or to the left, depending upon the direction of rotation. Diagrams of connections are given for various control schemes in which it is shown how the number of control wires may be reduced by suitable connections.

Telephoning by Means of Invisible Light.—Interesting work has been done by Messrs. J. Herbert-Stevens and A. Larigaldie of France in the direction of wireless telephony employing infra-red beams of light. The source of light used for infra-red signalling is an arc searchlight or an electric lamp, the light being passed through an absorbing screen of black manganese-dioxide glass or of colored gelatine or cellophane. The receiver consists of a parabolic mirror, with a special thermopile at its focus. The use of this thermopile in conjunction with a valve amplifier has enabled communication to be established at distances of over 15 miles. The thermopile is so constructed that its inertia is almost zero. A metal plate 0.01 mm. thick is sealed by autogenous fusion on the point of a crystal of great thermo-electric power. The best results have been obtained with platinum and a crystal of tellurium. A glass cell is used to contain the two and is provided with a fluorite window. The thermo-electric couple is connected to a vacuum-tube amplifier, the current being broken by a tikker at a musical frequency, and a potentiometer is included in the circuit to eliminate any currents due to local conditions causing temperature variation of the junctions. A complete description of this system of telephony, together with photographs and diagrams, appears in the next issue of this journal.

Science

A New Abstracting Journal for Geology.—The general secretary of the Société Géologique de Belgique, with headquarters in Liége, announces that the society proposes to publish a monthly abstracting journal devoted to all branches of geology and cognate branches of science. It is to bear the French title *Revue des sciences minérales*, and the English title *Review of Geology and Connected Sciences*.

Motion Pictures of the Roosevelt Elk.—A field study of the Roosevelt elk has been undertaken by Dr. Barton W. Evermann in the Olympic Mountains, west of Puget Sound. He is accompanied by an expert motion-picture photographer, who is expected to secure films showing this animal in its wild state and its native habitat. The pictures are to be used by the California Academy of Sciences in its educational work, to supplement a habitat group of these elk which the academy is installing in its museum in Golden Gate Park.

The British Association.—The meeting of the British Association for the Advancement of Science held at Bournemouth in September, 1919, was the first meeting of the association since that held at Newcastle in 1916 and was attended by upwards of 1,200 members. The inaugural address of the president, Sir Charles Parsons, was devoted in part to the scientific developments of the war and their peacetime applications. Prof. W. A. Herdman, who has been general secretary since 1903, has been elected to fill the office of president for the year 1920-21. The next meeting will be held at Cardiff.

"The Face of the Earth."—The vast and epoch-making work of the late Austrian geologist, Eduard Suess, "Das Antlitz der Erde," appeared in parts between the years 1883 and 1909. An English translation, "The Face of the Earth," by Miss Sollas, of Oxford, was published 1904-1909. Recently there has appeared the final installment of a French translation, prepared by the distinguished geographer Emmanuel de Margerie with the aid of 17 collaborators. The French version has been appearing in parts since 1897. The index alone fills 176 pages. The French translation contains much supplementary material, including a great fund of new bibliographic references and a large number of illustrations not found in the original work.

Effects of Illuminating Gas on Plants.—A recent German publication by C. Wehmer describes studies on the effects of passing continuous streams of illuminating gas through soil bearing potted herbaceous plants and also wooded plants from three to seven years' old. Actively growing herbaceous vegetation was rapidly killed. Trees were killed during the spring period of rapid growth, while in late summer and early autumn the injury was mainly limited to the dropping of leaves. During the dormant period of winter the trees showed great resistance. As to seeds, it was found that the embryo in resting seeds and the seedling stage were both very sensitive to the effects of the gas. The author finds that the injury is caused by toxic substances in the gas, and not by mere displacement of oxygen, as has been suggested by Sorauer.

The Hogshooter Gas Sand.—An interesting contribution to the study of petroliferous deposits is made by Mr. Walter R. Berger in an article on "The Extent and Interpretation of the Hogshooter Gas Sand," published in the *American Journal of Science*. The Hogshooter natural gas field, in Oklahoma, is about 12 miles in length and from a mile to a mile and a half in width. Several hundred records of wells drilled in this region show the sand horizon to be a continuous body of sand in a north-south direction, but very narrow and lenticular in the east-west direction. All available data lead to the conclusion that the Hogshooter gas sand is the sand deposited by a large river along its course. This conclusion, says Mr. Berger, is strengthened by the fact that there was, at the time the sand was deposited, a topographical depression (interpreted as being an old river valley) in the area where the sand body is found. Narrow and comparatively thin eastward and westward extensions of the Hogshooter sand are believed to be deposits made by tributary streams.

Industrial Efficiency

A Steamer as a Traveling Exhibition.—A plan is reported in the *Japanese Weekly Chronicle* for chartering a steamer of 10,000 tons, remodeling it into a suitable show place for Japanese products, and sending it around the world. At each foreign port at which the ship stops, representative citizens will be invited on board and made more familiar with Japanese merchandise.

The French Identity Card.—A decree of November 29th last, published in the *Journal Officiel* of December 2nd, specifies the style of professional identity card which must be carried by all commercial travelers and representatives of business firms working in France and the nature of the information which must appear thereon. These cards will be valid for one year from date of delivery to the holder. A charge of 10 francs is made for each card delivered.

Memoranda in Glass.—A reader tells us that with the use of gum tragecanth, allowing a week for drying, two sheets of glass can be joined with a sheet of paper between them, without the slightest staining of the paper. It is suggested that this provides a new and useful means of making paperweights and other glass articles with calendars, etc., embedded in them. The gum, while still wet, appears to have stained the paper; but every trace of this disappears as the drying out proceeds.

Profit Sharing in Germany.—In the second week of December last, the representatives of the Siemens concern at Berlin held a meeting to consider the question of admitting salaried employees and wageworkers of the great factories to share in the profits. At this meeting the representatives of the workers stated, among other things, that the directors of the Krupp Company were already negotiating with the employees about the form of profit sharing. The corporation will issue shares for small amounts, 100 or 200 marks, so that its employees may in this way participate in the dividends. It has also been proposed to organize a coöperative association among the workers which would receive their savings and invest the money in shares of the corporation. The Krupp firm favors these plans. The Siemens concern will make some similar provisions for its workers. Other large firms in Germany are negotiating with their employees and the results achieved thus far are said to be favorable.

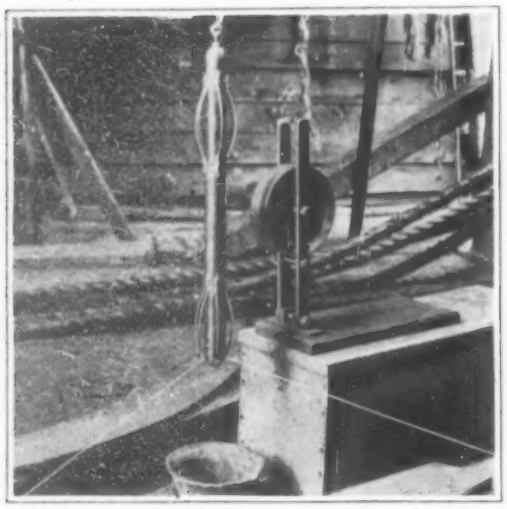
Buying Gas According to Its Heat.—It is reported from England that a change in the method of charging for gas is now proposed. The suggestion is that instead of buying gas by the cubic foot, the consumer should buy it on the basis of the heat it is capable of developing, as for nearly all uses to which gas is now applied its heating value is the desiratum. Under the new scheme of charging the consumer will be presented with a bill for so many heat units instead of so many cubic feet. The meter will continue to register cubic feet, but the consumer's bill will be rendered in terms of "gas units." The gas company will be called upon to show what is the calorific value of the gas it supplies, and by multiplying the cubic feet registered on the meter by the calorific value, the number of units to be charged for will be arrived at.

When Is a Ladder Safe?—There seems to be such a general lack of knowledge of the angle at which ladders should be placed to secure the maximum of safety for the men working on them, that *Safety News* has prepared an interesting diagram showing the position of ladders of various lengths to ensure safe use. The angle of 75 degrees has been found, through a series of experiments, to give the greatest degree of safety, and to secure this angle, all that is necessary is to place the foot of the ladder a distance approximating one quarter of the length of the ladder away from the vertical. This angle will prevent undue straining of the ladder, or slipping of the ladder feet when placed too flat and at the same time will give the feet of the workmen sufficient room when they are working near the top of the ladder. Another point that should not be forgotten in connection with ladders is that portable ladders should be fitted with safety feet or points, in order that a sure grip on the floor or ground may be secured.

Our Deepest Wells

Some of the Scientific and Practical Problems Which They May Help Us To Solve

By Robert G. Skerrett



Thermometers encased in metal frame ready to be lowered into a deep well

THE deepest well in the world bored by man is not far from Fairmont, West Virginia, on the J. H. Lake farm. It reaches down into the earth's crust for a distance of 7,579 feet. The goal was a penetration of 8,000 feet to the Clinton sand which, at higher levels in Ohio, has yielded so richly of oil and natural gas.

For years, the well at Czuchow, Germany, of 7,348 feet, stood unapproached, and then our enterprising prospectors for petroleum and gas bored the Goff well in West Virginia about 8 miles away from Clarksburg; and before the last cable broke, leaving a ponderous string of tools at the bottom of the shaft, a depth of 7,386 feet was reached. This was in March of 1918, and was the result of 400 days spent in actual drilling.

The Lake well was started in June of 1916, and by September of 1917 had attained a depth of 6,720 feet. Work was halted at that point awaiting a new cable, but the war delayed its receipt, and it was not until the end of October, 1918, that drilling was resumed. This was continued until the 12th of June of last year, when a cave-in far down in the hole put a stop to further operations. On that date the drill had penetrated to 7,579 feet. The cause of the choking was due to a failure to line the bore throughout the lower section, a length of nearly 9/10ths of a mile. The surrounding pressure of the earth and the shock of the heavy percussion drill induced the collapse of the unsupported shaft.

As in the case of the Goff well, the ultimate objective was not attained—a penetration of 8,000 feet; but the man that made the Lake well possible is nevertheless confident that, with a suitable reinforcement of casing, there is no reason why drills should not pierce the earth's shell to a depth of quite 10,000 feet. The practical minded person will ask, "Of what avail are these costly pin pricks, so to speak, into the terrestrial crust which, 'according to the book,' has a thickness of something like a thousand miles?"

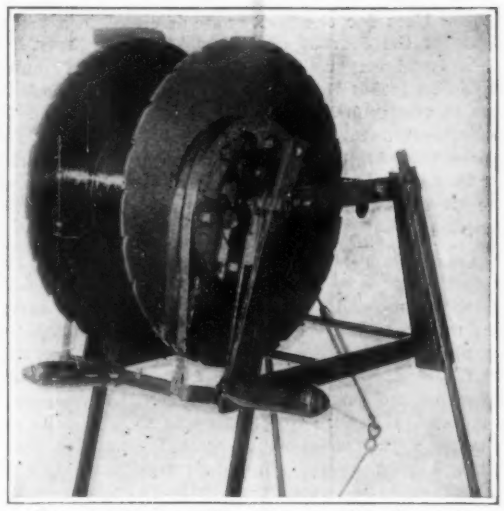
It seems that the total cost of boring the Goff well was in the neighborhood of $50,000; that of drilling the R. A. Geary well, a few miles away from McDonald, Pa., of 7,248 feet, was $100,000; while the Lake shaft entailed an outlay of approximately $29,000. The differences in expense may be explained by the varying geological difficulties that had to be combatted. A water pressure of nearly 3,000 pounds to the square inch crushed in the tube casing at the bottom limit of the Geary well, burying the drilling tools and effectually stopping penetration into the Clinton sand but a few hundred feet away. But just see what the drilling of that shaft did reveal of potential economic and commercial value.

After the drills had pounded their way beyond a depth of 6,800 feet, they struck layer after layer of rock salt ranging in thickness from 5 to 10 feet, establishing conclusively that these strata extended in unbroken sheets throughout an area of many thousands of square miles. As one eminent geologist has expressed it, "It is barely possible that in addition to the vast quantity of common salt, or sodium chloride,

What the deepest well means in comparison with the Woolworth Building

in these great underground deposits, some of the potash salts, potassium chloride, and potassium sulphate, may also exist and will be found interbedded among these other saline products."

There is warrant for the belief that these seemingly unfruitful efforts to obtain petroleum and natural gas have served to disclose the remains of fossil ocean water imprisoned in mid-Paleozoic time, which may



The reel for the cable used in sending down the electric-resistance thermometers

make us absolutely independent of Germany in the matter of the potash so essential to the revitalizing of our cultivated acres. But the Geary, the Goff, and the Lake wells are furnishing us a wealth of scientific data of several sorts. Samples of the rock materials, chips of slate, etc., have been studied by the U. S. Geological Survey; and evidences of fossil life from the Goff well were brought to light from a depth of 7,355 feet, while other formations have tended to establish in a wonderful way the harmony of the stratification and wide distribution of the same orders of life over thousands of square miles of the earth's erstwhile surface. These remains of eons gone tell in their mute way of the manner in which the present habitable terrestrial crust has successively been above and below the sea.

The deepest mine in the world is shaft No. 3 of the Tamarack mine, Michigan, which is down 5,200 feet below the surface. The sinking of a mining shaft is limited by human endurance, because the heat of the rocks at a depth of more than a mile is so high that workmen cannot bear up under it even with the help of artificial ventilation. On the other hand, a well can be bored 6 inches in diameter to a far greater depth—penetration depending upon the strength of the cable, the design of the drills, and the skill of the men who "feel" from the ground level just how the far-off tools at the length of the steel line are doing their work. The drills weigh anywhere from one to two tons, and the wire rope maker has proved that he can fashion cables capable of bearing the stresses of lifting and dropping these loads as the tools pound their way downward.

Thanks to the researches of Mr. C. E. Van Orstrand, physical geologist of the U. S. Geological Survey, the three deep wells in question have enabled us to find out a number of suggestive things about subterranean temperatures pointing the way, perhaps, to the practicability of our tapping the earth's vast reservoir of heat for industrial and other purposes. We are told that the center of our globe is composed of an incandescent nucleus ranging in temperature from 3,000 degrees to 180,000 degrees Fahrenheit. These figures, however, have little value, for the U. S. Geological Survey tells us that mathematicians have not yet found the law of the distribution of temperature from the surface to the center of the earth.

It may seem far-fetched, then, to imagine that these deep yet relatively shallow wells will help us to establish this law of distribution, and yet the temperature readings obtained by Mr. Van Orstrand, by means of instruments which he has skilfully devised, may eventually give the world of science the key to Nature's riddle. In the Geary, Goff and Lake wells, the temperature at a depth of 100 feet is about 55 degrees Fahrenheit. This gradually rises the further down the thermometers are lowered, reaching 142 degrees Fahrenheit in the Geary well at a depth of 6,100 feet; 159.3 degrees Fahrenheit in the Goff well at 7,310 feet; and 168.6 degrees Fahrenheit in the Lake well at a depth of 7,500 feet. The observation at 7,500 feet in

(Continued on page 230)

Gaging Screw Threads with a Beam of Light

By Merrill M. Hunting

THERE will be no uncertainty, no wearing of gages, when the recently perfected machine, known as the comparator, comes into general use for the inspection of screw threads. The end thread tells the entire story and a shadow of this is projected on a specially prepared chart used in connection with the machine. There will be no argument about a "fit"—the naked evidence is photographed, and there is nothing more truthful than the eye of the lens. This invention constitutes one of the most important advances in making dependable all machines and mechanism using threaded parts. Its use means a speeding up of production and a reduction in cost of good threads.

The old gaging systems in use generally depended upon the "feel" of the gage. The inventor of the new machine, Mr. James Hartness, president of a well-known firm of machine designers of Springfield, Vermont, has realized that this has been a blind system and that it must be eliminated in this age of modern methods. Any engineer knows too well that many machine failures are due to misfitting screws. A loose screw in an airplane may mean death. The gasoline engine of the motor car must not have loose screws, and its nuts and bolts are provided with various locking devices. However, there are many applications in which locking devices cannot be used, and so the faulty screw must go. Through a clever use of the projection lantern, we can now discover in a most practical way the essential elements of the screw in the process of being produced. In other words, the screw's shadow tells the tale.

The screw inspection machine has a lamp housing, a work holder, and the necessary lenses all mounted on suitable arrangements. The tolerance chart used in connection with the machine is held in place on a bench-like frame. The apparatus takes up a floor space fifteen by seven feet. The magnifying lenses are specially selected to fit the requirements of screw thread inspection.

Because the machine uses a projection lantern, one might think that a dark room is necessary. It is not. In fact, it is not even desirable. A moderately-lighted location will answer the purpose admirably. There is provided a work-holder in which the screw thread is positioned longitudinally by the threaded nest. The threaded nest is about five threads distant from the thread that is opposite the projecting lens. If the lead is not as it should be this thread will not be directly in front of the lens, but a trifle to the right or the left. This change of position shifts the shadow on the chart. When the machine is correctly adjusted the shadow profile on a thread in the holder will be

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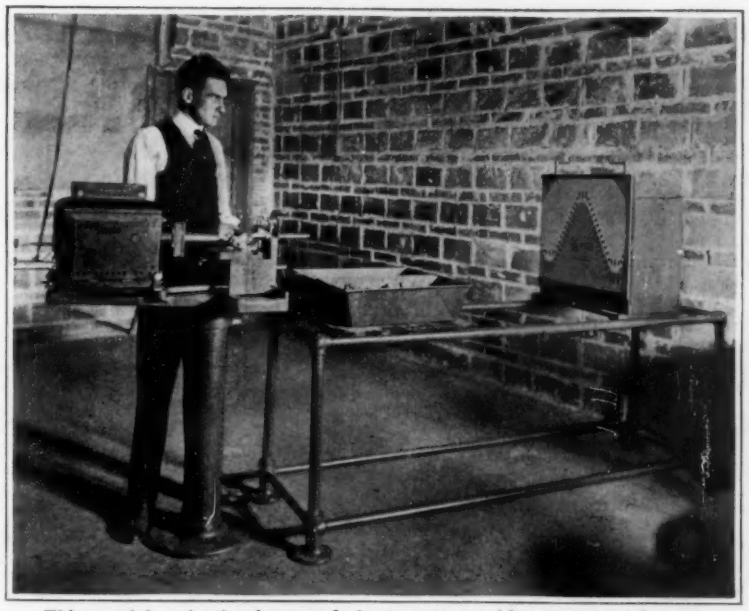
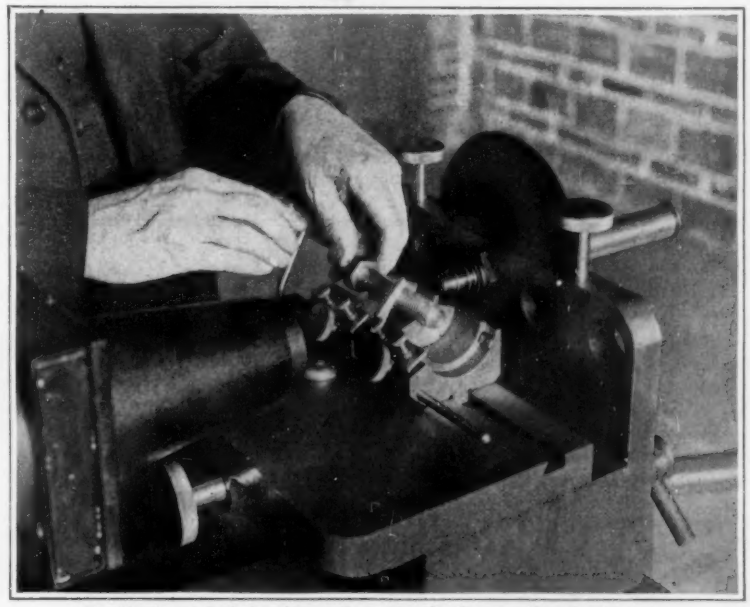


This special projection lamp and chart screen enable accurate and rapid screw-thread inspection by means of the screw's shadow



Positioning a bolt in place prior to projection on the chart screen

What About Our Commercial Aviation?

By George Gaulois

IS our aviation effort about to disappear? Perhaps not, but for a certainty it has become more and more feeble since the armistice brought our participation in the world conflict to an end. Aircraft companies have been left with little to do, and it is small wonder to find most of them engaging in other lines of work in order to keep their plants at least partly in operation. All of which, to be sure, is regretable in the extreme, for the air force of any nation cannot be built up overnight in the event of national peril.

While we here in America have permitted our aviation to drop back into its prewar inactivity, the European belligerents have gone ahead with commercial projects. The British, French, Italians and Germans have established successful passenger-carrying services and even cargo-carrying services, not to speak of numerous and long-distance aerial postal routes. Even the Swiss are inaugurating passenger-carrying services in order that the tourists may enjoy the new thrill of viewing the Alps from on high. But what has been done in Europe cannot be duplicated in the United States quite so readily, because the Europeans have always taken more kindly to aviation than we have, and their governments have ever been ready to aid aircraft designers and manufacturers in every way. With such encouragement the European aircraft fraternity have enjoyed a tremendous advantage over the Americans, who have had to struggle alone except for the short span of the war.

With little or no encouragement coming from the Government, American aviation must depend on the commercial side of flying. The great problem today is: What practical use can be made of airplanes, what volume of business can we expect to secure with them, what changes of or developments from present military machines will be necessary to give us an efficient commercial machine, and what does the future hold for this new means of transportation?

Since speed is the great, outstanding present-day advantage of the airplane, according to a paper read by D. W. Douglas, chief engineer of a leading American aircraft company, before the Society of Automotive Engineers, the passenger-carrying feature ranks first in importance. Many of our daily business and personal affairs can be successfully conducted only by a personal meeting or inspection. Correspondence, telephony and telegraphy cannot supply the complete satisfaction of actual personal contact. Where any

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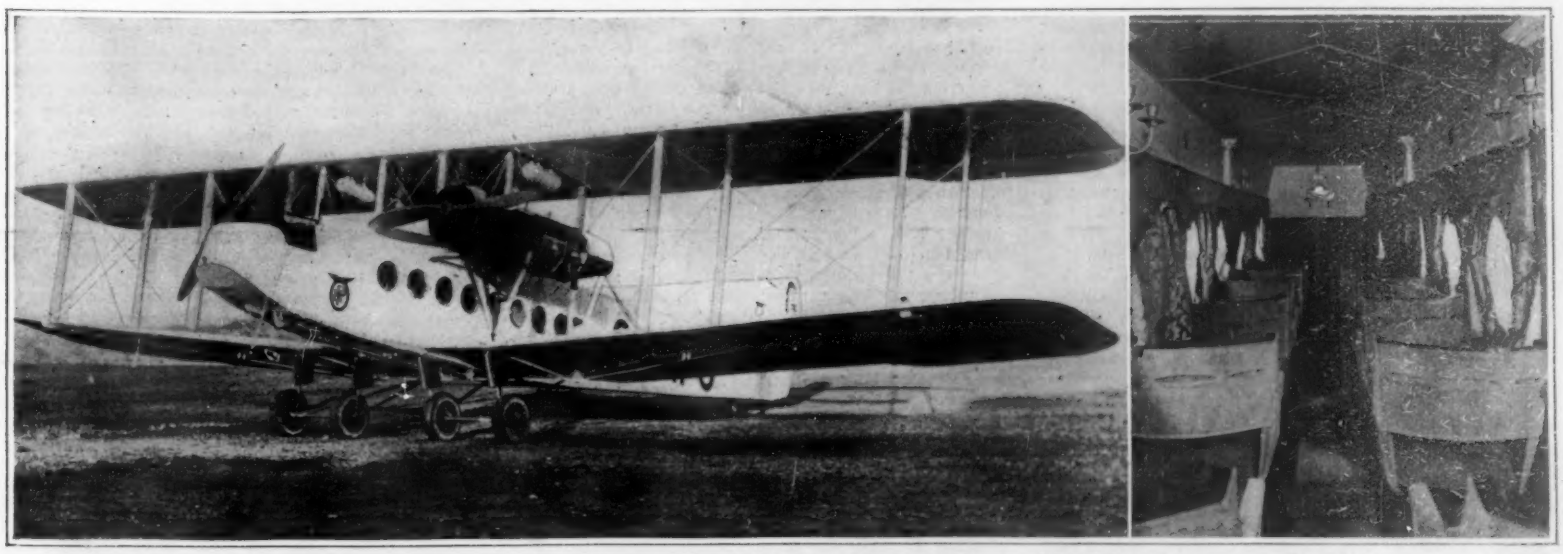


Passenger-carrying Handley-Page machine recently exhibited at the Paris Air Show, and its elaborate passenger saloon

The Fruits of Scientific Farming

Proofs of the Pudding Which the Department of Agriculture Has Been Cooking These Many Years

By C. H. Claudy

IT is not so many years ago that the now huge Department of Agriculture was housed in one modest building. It is now, in spite of its two new buildings, housed pretty much all over Washington, and has branches and agents pretty much all over the country. Laughed at and derided by farmers who were hidebound in the traditions of soil cultivation as taught by word of mouth from father to son, it has pursued its educational course, experimenting, learning, teaching by exhibits, by bulletin, by lecture, by example, and slowly but very surely, raising the level of agricultural education throughout the Union.

We have all known, in a vague and hazy sort of way, that any educational campaign, carried on for a sufficient length of time, must yield results. But we have —we of the general public—hoped rather than been confident, that the Department of Agriculture could improve farming methods to the point of making a dent in statistics and the high cost of living. What we have hoped is now an accomplished fact, although by no means a perfected accomplishment, and the proof is here before you to read.

Over a period of years, the fluctuations of climate, local weather, insect pest and other causes which affect the yield per acre, are equalized and leveled. It is not possible truly to compare the yield per acre of this year with that of last, or last year with the year before, because so many variables exist in the result. But the average for a period is not varied by these extraneous factors . . . the average for a period of years is the true yield per acre. So that if the yield per acre of ten years be compared with the yield per acre of another ten years, and there is a difference and that difference is favorable one must either conclude that the weather over a ten-year period was more favorable than over another ten-year period, or that agriculturists are learning and during one period have done better than during another.

The reports show statistics for many crops, but a few are selected here and quoted as examples. For the ten years ending 1890 the average yield per acre of wheat was 11.84 bushels, for the ten years ending in 1918, it was 14.87—an increase of 25 per cent. For the ten years ending in 1890 the average yield of corn in the United States was 23.43 bushels; in the ten years ending 1918 it was 25.81 an increase of 10 per cent. The oats yield in the ten years ending in 1890 averaged 23.92 bushels, but in the ten years ending in 1918 it was 32.17, a gain of 24 per cent. The potato crop averaged 72.97 bushels per acre for the ten years ending in 1890, and 96.84 for the last ten years, an increase of nearly one-third. The hay yield rose from 1.193 tons per acre to 1.432—an increase of twenty per cent. Cotton, notwithstanding the ravages of the boll weevil, increased from an average of 169.78 pounds in the decade ending in 1890 to 175.73 in the last decade—a gain of 3½ per cent. The average increase per acre of all crops in the ten years ending in 1918, compared with the ten years ending in 1890, is about 16 per cent.

The tendency towards enlarged output per acre is general throughout the United States; it is not due to a shifting of production from one section to another. In the old agricultural State of New York the increases for the two periods mentioned above were as follows: Corn, 24 per cent; wheat, 44; oats, 21; barley, 24; buckwheat, 43; potatoes, 30; hay, 10; average of all (weighted) 18 per cent. For the six New England States, the following gains are shown in the ten-year period, 1909-1918, over the average for 1866-1875: corn, 33 per cent; wheat, 63; oats, 25; barley, 27; rye, 27; buckwheat, 17; potatoes, 27; hay, 24; and all field crops, 25 per cent: and for the ten years, 1909-1918, over the average for 1881-1890: corn, 38 per cent; wheat, 60; oats, 24: barley, 29; rye, 44; buckwheat, 45; potatoes, 69; hay, 23; and all field crops 26 per cent.

Our average yields are frequently compared with the much larger yields of some European nations. In Belgium the average yield is about double that in the United States; in the United Kingdom, more than 60 per cent greater, and in France, nearly 15 per cent. But the energy of each American farmer is spread over a large area and although he produces less *per acre*, he produces much more *per man*. The total output of the average United States farmer is greater than that of any other country in the world. In Belgium, with its intensive system of farming, only about 5.3 acres are cultivated for each person engaged in agriculture, whereas, in the United States, the corresponding figure is 27 acres. Taking acreage and yield per acre into consideration, the average American farmer produces 2.5 times as much as the average Belgian farmer; 2.3 times as much as the English; 3.2 times as much as the French; 2.5 times as much as the German; and over six times as much as the Italian.

There must be a reason. Patriotism may urge the reply that an American is a better man than a Belgian or a Frenchman or an Englishman, but such an argument, flattering as it may be to vanity, has no place in statistics. If the American farmer is raising his yield per acre to such an extent that he produces more per man by many times than his European brother-agriculturist, it must either be that he knows more about gettting results or that he has better opportunity.

That yield per acre of small foreign farms is greater than yield per acre of larger American farms is sufficient proof that he has no greater opportunity as far as land and climate is concerned. The only other answer possibly is that the modern methods which the United States has discovered, fostered and put into practice have made the American farmer a better workman with the soil than his foreign competitor.

The ramifications of the Department of Agriculture are so numerous and the activities of this branch of the government so diversified that it is difficult if not impossible to pick on any one and say "this is a typical example." But let us take the Office of Farm Management and see what it does practically for the farmer. Leaving out of consideration its work in investigation, in publication and in experiment, it comes intimately in touch with the individual farmer. He has a problem. It may be of what to plant, best to conserve land slowly getting exhausted with a certain crop. It may be on the profitability of installing a water system or an accounting system. It may be on a matter of hours, wages or transportation. Whatever it is, the individual farmer can write to Farm Management and have instantly available to him the experience of other farmers with the identical problem, plus the advice of an expert whose business it is to consider and solve just such problems. If but one farmer took advantages of such a possibility we would never see the results statistically, but if enough took advantage of this concise, government-made-information, the result must inevitably show.

It took a good many years for the good roads educational campaign to get its roots down deep enough to grow into any sort of tree. But it is a big tree now and gowing bigger and the Office of Public Roads can point to its work in making better highways as one very good reason why yield per acre is better. Good roads save time, as well as money. The more time saved, the more time for farm work.

The Weather Bureau saves millions annually by its storm warnings. No other country in the world has a Weather Bureau like ours, very largely perhaps, because no other country has so large an east-and-west expanse or such possibilities for getting out-at-sea weather reports. Whatever the cause, the weather service must inevitably raise the yield per acre as it saves crops by timely warning.

Those who farm by rule of thumb look at the land and its color and say "looks good for corn or wheat or potatoes or whatever" and proceed to plant. Any farmer who will send samples of his soil to the Bureau of Soils can ascertain exactly, not by guess but by test, what crops his soil in his location is best fitted to produce. Obviously, this must, in time, increase yield per acre, since the land which will produce a large yield of wheat per acre will not do the same for cotton, for instance.

But outside the numerous activities of the Department, of which the above are only small examples, there have been certain legislative enactments, fostered and favored by the Department, which have had and must continue to have an effect on yield per acre. Of these the more important may be briefly mentioned:

The Bureau of Markets, excelling in the character and extent of its activities any other similar existing organization.

The Coöperative Agricultural Extension Act, disseminating information among the farmers, mainly through trained agents. There is now expended annually, from Federal, State and local sources, more than $14,000,000 for work contemplated by this act.

The Cotton Futures Act, under the provision of which standards for cotton have been established, the operations of the futures exchanges supervised, and the sale of cotton put on a firmer basis.

The Grains Standards Act, which brings uniformity in the grading of grains, enables the farmer to obtain a fairer price for his product and affords him a financial incentive to raise better grades of grain.

The Warehouse Act, which authorizes the Department of Agriculture to license bonded warehouses and which makes possible the issuance of reliable and easily negotiable warehouse receipts, permits the better storing of farm products, increases the desirability of receipts as collateral for loans, and promotes the standardizing of storages and of marketing processes.

The Federal Aid Road Act, which makes available $294,000,000 for coöperation between the Federal and the State Governments in the construction of rural roads. It has conduced to the establishment of more effective highway machinery in each state and strongly influenced the development of good road building along right lines. It will stimulate larger production and better marketing, promote a fuller and more attractive rural life, add greatly to convenience and economic welfare and strengthen the national foundations in every one of the many essentials which depend for their development upon the linking up of all sections of the country with one another by means of effective highways.

The Federal Reserve Act, which authorized national banks to lend money on farm mortgages and recognized the peculiar needs of the farmer by giving his paper a period of maturity for six months, so that he can get the money from the bank when he needs it and pay it back when in the natural course of events he has it.

The Federal Farm Loan Act, which creates a banking system reaching intimately into the rural districts and operating on terms suited to the farmers' needs. It is attracting more capital into agricultural operations, bring about a reduction of interest to farmers and placing upon the market mortgages which are safe investments for private funds.

The Vocational Education Act, which, among other things, provides for coöperation with the States in the training of teachers of agriculture and in giving agricultural instruction to the pupils in secondary schools.

These, as well as the other usual activities of the Department of Agriculture are the cooks of the pudding which we prove with our statistics. In other words, better government, better education, better farmers, better yield per acre, more food and better profits!

IN anything cooked, the omission of one single grain of salt or the addition of one single grain of sugar, could not be detected by the most critical taste; omission or addition must be of some size to be detected. In a country the size of this one, the education or lack of education of one individual cannot be detected in any compilation of statistics, vital, commercial, economic. Nor can the result of any campaign of education be detected in a short period of time. It is only when we cook our national pudding for many years, during which we keep on adding small grains of educational salt or sugar, that we begin truly to taste the results. All of which is introductory to some amazingly interesting facts disclosed about the United States Government's activities in fostering the science of agriculture, as deduced by Mr. Claudy from the latest report of the Secretary of the Department of Agriculture.—THE EDITOR.

Motor Bus vs. Street Car

Some of the Reasons Why the Truck Is Doing So Well in This Competition

By R. E. Fulton

IN a consideration of the reasons for the growing acceptance of the motor bus as an economic necessity in passenger transportation, it is well first to examine the ultimate effect of increases in population upon traffic facilities. While the necessity for immediate action to solve serious congestion problems is now being felt only by the larger cities, the requirements of smaller cities and their future development deserve just as much consideration to prevent this congestion in years to come.

It is evident that the traction lines are becoming more and more inadequate to handle the congestion that is increasing every day. Since the amount of traffic they will hold is limited by the tracks on which they run, it will be impossible for them to keep up with the growing needs of transportation unless new tracks are laid. This, however, is prohibited by the increasing congestion of privately owned vehicles on the highways. Increasing population on the one hand demands more public transportation facilities. The increasing number of privately owned passenger and commercial vehicles on the other hand demands better highway facilities. Can one factor be satisfied except at the expense of the other?

The present serious financial condition of these public utility corporations throughout the country is bound to mean increased fares, and the burden imposed upon them by increasing population is bound to mean more and more congestion. The motor bus will not only solve the serious traffic problem, but will provide the public with a more flexible satisfactory mode of transportation at a lower cost.

In the majority of large cities it is out of the question to lay more tracks for surface car lines in thickly populated business and residential sections—there is no room for them. In view of this fact it is only logical to assume that motor buses will be used to relieve the congestion, as they are free to operate on any route without tracks. And it is very possible that the time will come when traffic will have increased to such an extent that the streets will seem unable to hold it. In this event the only solution would be the discontinuance of surface car lines and the substitution of motor busses. This for the simple reason that busses neither block the highways nor are easily blocked, being flexible and able to move about in traffic. Surface cars, on the other hand, do block traffic and are easily tied up themselves by a block.

As far as less thickly populated sections are concerned there is every reason to believe that future development of transportation facilities will favor the motor bus. The laying of tracks for a surface car line represents a huge initial expense for right of way, bridges, grading and rails. If such a line does not prove profitable, it cannot be diverted. The flexibility of the motor bus system, however, does not confine it to any one fixed route.

Public utility corporations everywhere are gradually losing the faith of investors. Their inability to increase fares to keep up with increasing costs of operation considerably decreases their dividends. In view of this, it is becoming increasingly difficult to find investors who will lend the money to build and equip new traction lines, while far better inducements are offered in other securities.

Efficiency and economy of operation are in favor of the motor bus. These economies are principally due to the fact that the tremendous overhead expenses of the surface car lines are eliminated in the operation of motor busses. The bus is its own power plant and it consumes power only when in operation. Since it is speedier than the surface car, a bus can make more trips per day thereby increasing the revenue per unit of expenditure.

Motor bus routes offer many conveniences that cannot be offered by traction lines. Another point—they unload passengers at the curb which is much safer. In case of a blockade, a bus can detour. This fact alone works as a benefit in two ways—it makes a more dependable transportation system and tends to relieve the congestion incidental to blockades. Not being confined to tracks, busses can receive and discharge passengers nearer to their homes. Then, too, we have the obvious fact that people would rather ride in a motor bus not only because of its conveniences but because of the suggestion it conveys of pleasurable outdoors.

The motor bus is also a big factor in solving the industrial labor problem. Factory sites within city limits where labor is available, are scarce. The use of busses to carry employees to outlying sections where sites are obtainable is gradually being recognized as the logical solution to the problem.

A short time ago a party of ladies left Easton, Pa., in a pneumatic tired motor bus to attend a matinee theater performance in New York City, a distance of 73 miles by train. They left in the morning, arrived in plenty of time for the matinee and returned to their homes in the bus that same evening. Such illustrations of the potentialities of the motor bus make it easy to conceive the time when commuters will travel to business in busses more quickly and comfortably than by means of suburban trains. Metal laid roads designed for one-way motor traffic with no speed limit are inevitable.

All through the development of passenger transportation in every section, from the large city to the rural community, the motor bus will be felt more and more as the years go by.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Bombardments from the Skies

To the Editor of the SCIENTIFIC AMERICAN:

In the article under the above title in your issue of December 13, it is stated that "A body of matter entering the earth's atmosphere from outer space is intensely heated at its surface by the friction of the air, and hence becomes luminous."

Is it not possible that the meteor, consisting of iron or a large percentage of iron, of exceptional purity and of high electrical conductivity, is heated to incandescence by the heavy electrical currents induced in the body of the meteor caused by its entering the earth's magnetic field at terrific velocity?

Could the atmosphere be dense enough at the altitude where meteors are first seen to cause the amount of friction necessary to make luminous the amount of matter contained in some meteors that have reached the earth's surface?

It is possible that both the air friction and the eddy currents combine to produce the phenomena. Again: If the crater at Canyon Diablo, Ariz., had been made by the impact of a meteorite, would not it have been vaporized when striking the earth, leaving no traces except where some of the edges of the body were broken off when first entering the earth's crust.

The writer has made some interesting experiments upon high-velocity bodies; among these was the firing of lead bullets from a high-power rifle through ⅜-inch boiler steel, the rifle used was of .22 caliber of a well-known make, using a cartridge which gave a muzzle velocity of 2,800 feet per second.

The copper jacket on the projectile was usually left in the hole made by the bullet, a piece of timber placed 6 inches back of the steel plate usually showed no signs of the impact of the bullet or any part of it, which seemed to indicate that the bullet was vaporized in passing through the plate. Have we not here an exact analogy of the meteor crater?

R. H. PICKENS.

Clemmons, N. C.

The Rotary Bevel Shear

To the Editor of the SCIENTIFIC AMERICAN:

In your November 8th issue on page 464, under the subject of "Inventions New and Interesting, a department devoted to pioneer work in the Arts," you illustrate and describe an electric rotary bevel shear. We respectfully wish to call your attention to the fact that the particular machine which is shown in your publication was not originally developed at Wilmington, Del., and we would appreciate greatly if you would revise your statements.

For your information, the rotary bevel shear for the bevel shearing of plates and angles was originally designed and developed at Marshalltown, Iowa, back in the year 1892. Two types of rotary bevel shears were built. One was designed with parallel driving-shafts on which were mounted the cutting blades. There also was a machine accomplishing the same work, but the lower cutter shaft was on a horizontal plane.

Later we purchased this property, which included buildings, patents, good will, etc. At the expiration of the bevel shear patents, which originally were in the name of David Lennox, the Wilmington, Del., concern put on the market a duplicate of our Lennox machine.

In 1915 we improved the design of the machine by doing away with the nut holding attachment on the upper blade, to bring the machine within the reach of close bevel shearing work on angles, for which there was considerable call. The new design of holding the blades was by recess screws, and the general principle was patented, which patent this company now controls, and of which we claim the Wilmington model is an infringement. JOSEPH T. RYERSON & SON.

Chicago.

High Temperatures

To the Editor of the SCIENTIFIC AMERICAN:

It has usually been assumed that the highest attainable temperature is obtained from the electric arc.

We are all familiar with the burning glass and the great concentration of heat possible with it. Large burning glasses would be impracticable to make and would have excessive heat absorption.

However, by using a large parabolic reflecting mirror directed at the sun, the concentration of heat at the focus, would seem to be limited only by the size of the mirror, the accuracy of its surface, and the insulation of the impingent body. Temperatures equal to or far higher than those of an arc are easily obtained.

In an experiment in which the writer was interested at the Marine Searchlight Battalion, Philadelphia Navy Yard, a 60-inch parabolic glass mirror was directed at the sun: a one-half-inch steel bar held in the focus was melted in a few seconds; similar results occurred with a ½-inch asbestos board.

Assuming incident radiant energy of 5 B.t.u. per square foot per minute, and a mirror reflection of 85 per cent, there was about 1.8 horse-power concentrated on approximately .01 square inches section area of the focus in the above case. This would be at least four times the concentration of power as compared with the crater area of an arc of similar power.

The heat is potential, that is, unless there is an object at the focus for the rays to impinge on, the rays will merely cross and pass on.

It would appear that there could be experimental and commercial utilization of such a convenient source of high temperatures. W. J. PLATTEN.

Green Bay, Wis.

Quinoa

To the Editor of the SCIENTIFIC AMERICAN:

When quinoa has been developed into the wonderful breakfast food which Burbank and A. I. Root predict, I hope that someone takes the trouble to teach the Peruvian Indians how to cook it. I had to eat it daily for weeks when in the Andes and it was not well flavored nor even palatable. H. GULICK.

Gwallor, India.

The Steam Car

To the Editor of the SCIENTIFIC AMERICAN:

The improvements suggested for steam cars by your correspondent's letter in a recent issue are ideal if practical. Given a device as simple and dependable as the ordinary gage glass for *positively* indicating the true water level in the boiler, and place the pumps where they would be readily accessible and further improvements could be dispensed with, still leaving the "steamer" the logical car of the future and the most desirable at present.

The fundamental principles involved in the combustion of oils renders it unlikely that burners can be improved, to any extent, over present forms. I have had, perhaps, more trouble with "the fire" than Mr. Stanley ever intended to impose upon the sum total of his customers only to find, in the end, that 99 per cent of fault was my own, and I claim to be an oil fireman at that. WM. MOSTELLER.

Left: A combination house of adobe below and standard frame construction above, the first of the kind ever built. *Center:* Walls of a rather extensive house up and ready for the plaster. *Right:* The same house after the application of the plaster, three coats of which are needed for best results.

Building modern houses of adobe, most ancient of materials

Mansions of Mud

How California is Meeting the Housing Problem by Building in Adobe

By John L. Von Blon

THE world's housing problem, second in seriousness only to its immediate ally, the cost of food and clothing, may be approaching solution. Relief from the latter is promised with a show of sincerity, albeit without results, but no hope has been held out for a reduction in the excessive cost of the prevailing building materials; and while the quality has sadly deteriorated and prices have become wellnigh prohibitive the supply has dwindled to such extent or been so manipulated that contractors and others constantly are delayed and hampered in their operations and caused extra expense by inability to get this or that requisite. Lumber of all kinds and grades has turned to aviation and taken to flight without Liberty motors or other propelling power.

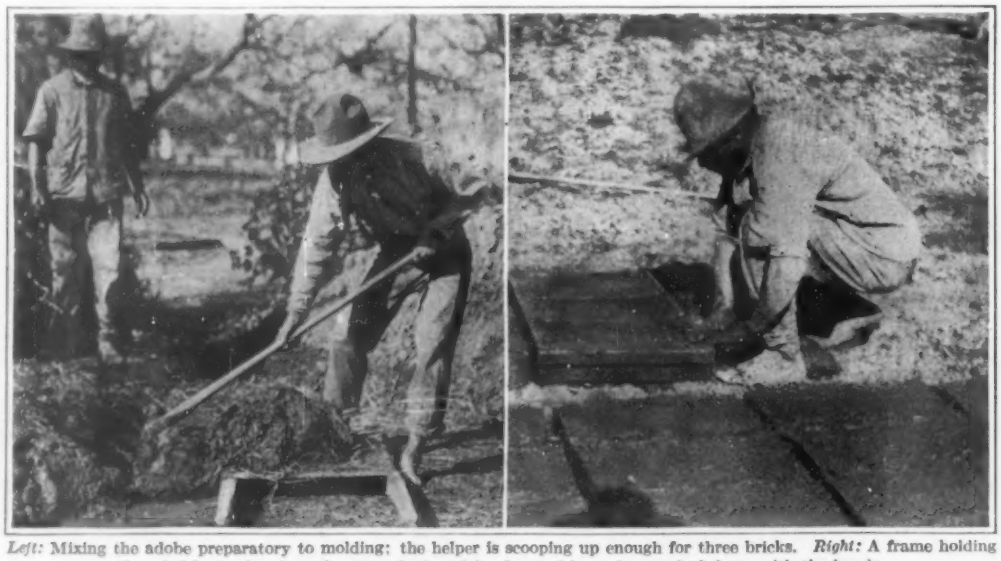
A pretentious house of adobe, with a dozen rooms, a "patio," and a garage, recently finished in Los Angeles

Enter now a new medium, yet old as the hills, to cheer the countless victims of skyscraping building figures. It is the lowly adobe—just mud, if you please—and may be the key to a perplexing situation. If it proves to be such the answer to the building dilemma, at least insofar as homes are concerned, lies in your own yard, the next lot or the adjoining field. The idea, likely to be ridiculed at first glance, comes from southern California. It is effective there; why not elsewhere? It is not impossible of adoption on a large scale in almost any community or region.

At Walnut Park, on the southern edge of Los Angeles, a broad-gage realty sub-divider is putting up two hundred attractive houses of adobe and demonstrating clearly its practicability. His magic white city, defying economic conditions which would preclude its construction of the materials in vogue, is rising in and about a 500-acre walnut orchard which was a small part of a famous old rancho. Some of the homes already are occupied. Many thousands of persons are watching with keen interest as the others are completed day by day. The feasibility of the undertaking remains unquestioned.

Adobe was used in the dim past, when first history was written on papyrus. Of it Nineveh was built. It has stood the test of ages and ever served its purpose well, and prevails today in Spain, Algiers, South America, Mexico and other lands. The early Californians employed it exclusively. It is merely wet soil mixed with straw, cast in molds of required size, and left in the sun to dry. Generally speaking, any earth with a clay base that makes it "gooey" and cohesive when watered will be desirable. Sand or gravel will not do. The process of manufacture is almost as simple as that whereby children turn out pies at the nearest puddle.

The mixing is best done by Mexicans with the bare feet in a sort of kneading up-and-down manner; hence the word "adobe," the substantive of "adobar"—to knead. One Mexican and his helper make 400 bricks a day—and they never have been known to speed up. The blocks are 16 x 10 x 4 inches and each goes as far as eight common bricks. Three at a time are molded in the simplest way. Their extensive manufacture by machinery is a prospect of the near future, inasmuch as the contractor is about to take up a patented device with a daily capacity of 7,000. The straw in the mud serves a purpose similar, though in greater degree, to that of steel reinforcement in concrete. It is absolutely essential and always has been. Four thousand years or longer ago when the Pharaohs bade the bondaged Israelites make as many bricks without straw as when this binder was supplied them, they were sore distressed; for they had to go out and pick it with their own hands. Give a peon an order like that and he'd shrug his shoulders, mutter something torrid, and throw up the job pronto!



Left: Mixing the adobe preparatory to molding; the helper is scooping up enough for three bricks. *Right:* A frame holding three bricks is placed on the ground, the adobe dumped in, and smoothed down with the hands.

Making bricks after a prehistoric technique

When the architect first looked into the early adobe construction with a view to its modernization he found the old southern California houses to be damp and insanitary because proper foundations and means of ventilation were lacking. These drawbacks he readily overcame. Seldom was there more constructive preparation than the crudest ground plan. The foundation was simply a layer of strewn stones with only mud as a mortar binder. Now concrete is used. The walls were eighteen inches to three feet thick, windows and doors were sparingly provided because glazing and mill work were extremely expensive, and there were no wooden floors. Tamped earth filled the bill. On this tule mats and Indian rugs were spread. The beams and rafters were made from hewn native trees. Across them saplings or wild canes were tied with rawhide thongs and on this thatch was laid the tile roof. These houses, with the picturesque California missions, have endured in some instances nearly a century and a half and stand today. The contractor points to them as proof positive that the material is good. And he has improved immeasurably on the former primitive methods of handling it.

He has established by temperature tests that adobe actually is the most nonconductive building material known. A brick has registered no more than six degrees' difference between extreme February cold and extreme September heat (in southern California). This shows the reputation of adobe for warmth in winter and coolness in summer to be founded on fact. He also has shown the material to be much stronger than ordinarily is supposed by developing a compressive

(*Continued on page 232*)

An unsuccessful attempt to melt the snow with flame-throwers left over from the war

Battling with Snow and Ice in the Streets of New York

By Ralph Howard

AT 2 A. M. on February 4th it began to snow in New York; with one or two brief respites, it snowed for about 80 hours; at intervals thereafter it snowed and hailed and sleeted some more. Several hard crusts were formed over the temporary surfaces of the snow as it lay, while much of it froze to ice. Altogether, about 22 inches of snow were precipitated. This is no record, even for New York; it was doubled in 1888 and has been surpassed at least twice since then. But today New York is peculiarly at the mercy of winter.

In the throes of revulsion against the "unsightly" overhead trolleys of Brooklyn, Manhattan installed her trolleys after a system which puts the contact wire in a ditch between the rails, closed at the top save for a narrow metal-lined slot through which the contact shoe passes. This slot is of course a weak spot in cold weather. A snowfall that is wholly trivial in Brooklyn or the Bronx may at any time tie up the Manhattan trolleys *in toto*, by freezing or caking in the slot; the only means of restoring traffic is then by thawing out the slot, foot by foot. As long as the cars run, the street cannot get completely tied up; the tracks at least will remain passable. But when the cars stop, from a frozen slot, the street is left as completely at the mercy of the falling snow as an unfrequented country road; while the impossibility of sending even a plow over the tracks means that clearing can ultimately be accomplished only by a slow and laborious attack from the ends of the blocks.

In the recent storm the trolley slots froze at an early moment, and thereafter the metropolis fought a losing battle with the elements. The decisive feature was the extraordinary duration of the snowfall after the trolleys ceased to run. And then, snow-shovelling forces must necessarily be recruited from the unemployed; and there are today no unemployed save those who shun employment. When the storm let up for a while on the 5th, the Street Cleaning Commissioner would have used 40,000 men to advantage; he had but 3,000, most of whom were unreliable.

On top of this, the motor truck demonstrated itself unable to cope with real winter weather. It is so heavy that it breaks through the snow to rock bottom; then, able to grip the roadway only at the point of wheel contact, and able to shift that point only after having gripped the road sufficiently to move itself, it spins its wheels and stays right where it is until it is shovelled out. So Thursday saw the streets of New York filled with a dense snarl of trucks tied up and unable to extricate themselves. Even where motion was possible it was intermittent; at every block or several times per block there would be a long halt while the trucks that were jammed together at the next corner backed and filled and tried to get untangled. Even where roadways were broken, they were single-track affairs, so that the problem of passing frequently led to long blockades while a truck that had ventured too far out into the deep snow was rescued and got back into action.

When the fall abated and the seriousness of the situation became evident, it was seen that hand shoveling would have to be supplemented with mechanical aid of some sort if the tie-up was to be ended promptly. And on the ground of the fire hazard alone, it was essential to end it promptly. Had a big fire broken out during the paralysis, the engines could not have reached it, and there would have been a calamity. As it was, several times the engines used the sidewalks, at great peril. So ingenuity was put to work, and various schemes for coping with the snow were tried out—some successfully, others not.

There are always people who advocate the melting of the snow where it lies. Whenever this is tried, however, it is found to be out of the question to pro-

(*Continued on page 232*)

Copyright, Keystone View Co.

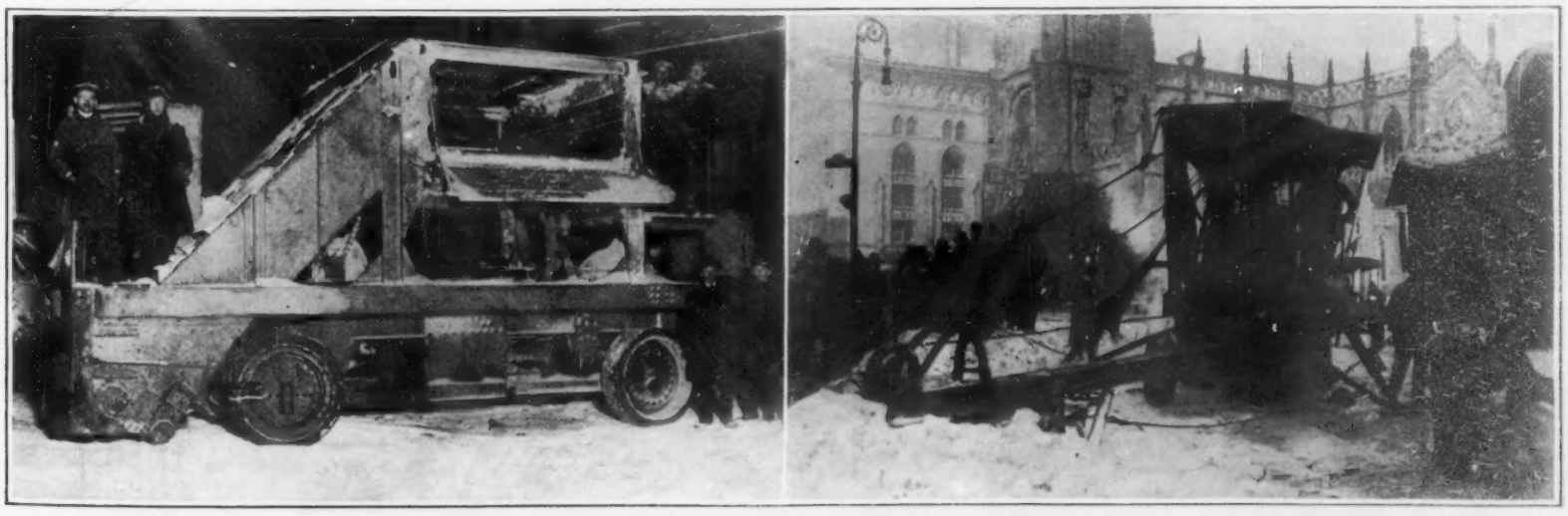
Another futile effort to burn the snow away with an implement modelled after the familiar asphalt-burner

Fire alarm with horn to warn traffic that the engines are coming

Clearing the Way for the Fire Engine

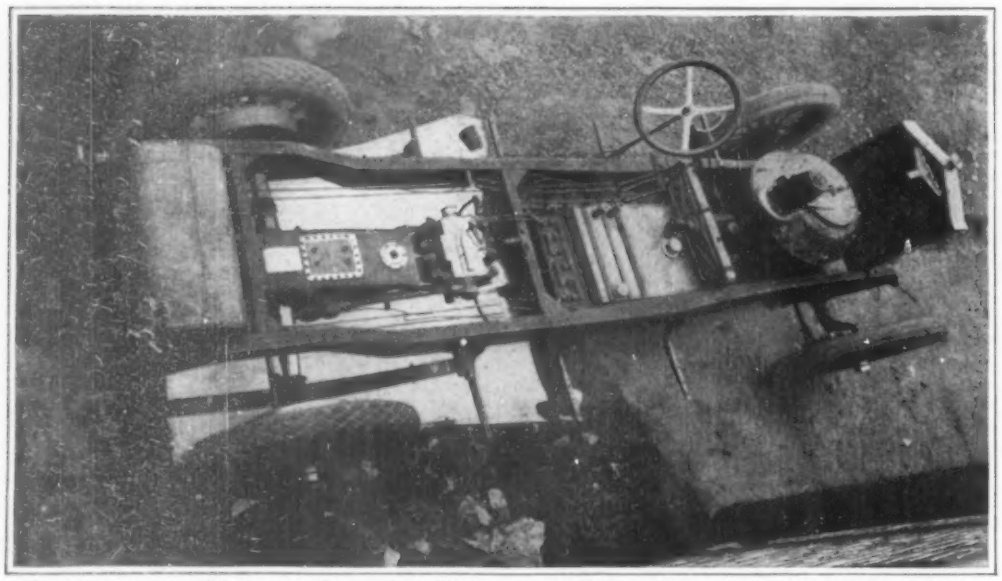
WHEN the fire engine comes plunging down the street to a fire, traffic laws are suspended, and the big truck gets a free right of way. But while it is entitled to this, and nobody tries to withhold it, giving the engine a clear path is not always the easiest thing imaginable. Some pretty bad accidents have happened through the desperate last-minute efforts of a driver to get out of the way, when sufficient warning of the juggernaut's approach had not been given.

It is with the idea of doing away with this wild scramble to get out from under the very wheels of the fire truck that Atlantic City has installed a system of electric horns in connection with its fire-alarm boxes. These boxes are located at every other corner along the principal thoroughfares; and above each box is a horn. The wiring of the system is such that whenever an alarm is turned in, all the horns on the route which the engines will follow begin at once to blow, and everybody on the street has ample time to get out of the way before the fire-fighters are actually upon them. Not only are accidents eliminated, but it is possible for the fire apparatus to be driven with much more confidence and accordingly with greatly increased speed. It is largely on this account that the Atlantic City fire department has established a record for its great speed in response to alarms. And surely a series of horns blazing forth their warning over the entire route to be taken is vastly superior to an excited "cop" dashing down the street in advance of the engines—the best warning system that we have heretofore had. There has always been a need for such a device, even in the good old days of the horse-drawn engine; but today, with our fire departments so thoroughly motorized, the need changes to absolute necessity.

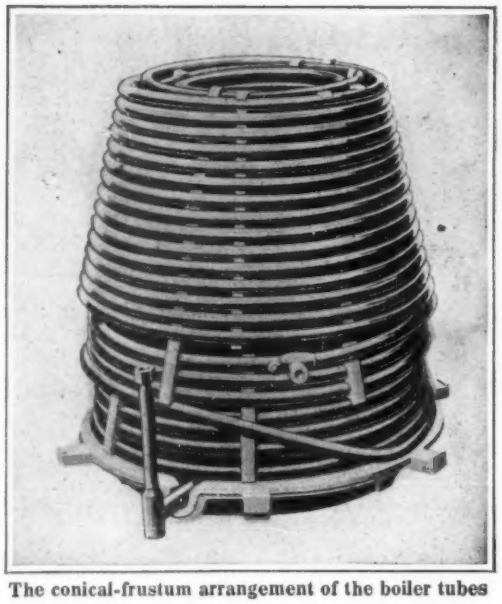


Left: A newly designed machine that digs up the snow, and either piles it at the sides of the street or delivers it at the rear to trucks. *Right:* Applying the steam-shovel idea to snow removal.

Mechanical means tried out in the effort to free New York from the blizzard



The arrangement of the power plant and auxiliaries, as seen looking down upon the chassis from above



The conical-frustum arrangement of the boiler tubes

Again the Steam Automobile

The Latest Effort to Produce a Steam Car with All the Advantages of Gas and of Steam

THE steam automobile, it seems, will not die. Everybody is using the gas car, but nobody seems quite satisfied with its performance, or quite ready to admit that it is the last word in automotive construction. Accordingly, we find ingenious people continually putting forward new versions of the ultimate car, propelled by steam; and the very wide vogue which this effort has attained forces us to ask on what grounds it is based.

The advantages claimed for steam propulsion are many. Some of the chief ones may be recognized in the ability to burn *completely* a low-grade fuel; the rapid acceleration without gear shift or clutch manipulation; the simple control by throttle valve altogether; the greater quiet and freedom from vibration; the high torque at low speeds; the greater overload capacity; the small number of moving parts, and the slow motion of these which makes them more durable as well as simpler than their prototypes in the gas-driven car; the ability to reverse while going full speed ahead; the impossibility of killing the engine at some critical moment; the elimination of transmission, gear-shift and clutch, of fly wheel and drive shaft, of universal joints, and above all else of the ignition system; the freedom from carbon and knocking; the emancipation from valve grinding; the absence of engine racing and smoky exhaust.

Against these, the drawbacks which have been noted in the steam automobile as worked out in the past may be summarized as time required to raise steam in a cold boiler; danger from fire and explosion; the labor and knowledge required in getting up steam, and the handling of dirty parts in this operation; the short life of the boiler and the attention required in blowing it off; the noise from the fire and the water pumps; the continual packing of joints; difficulty of maintaining an even, automatically controlled steam pressure and temperature; the use of two fuels, both under high pressure; the short water-mileage; the freezing problems in cold weather; the sooting of boiler coils, etc.

Messrs. L. L. Scott and E. C. Newcomb, of St. Louis, have been experimenting with steam systems for many years; and recently have undertaken the development of a steam plant for automotive use, with the intention that this plant shall preserve the advantages enumerated above and eliminate the disadvantages. They have had their system in successful operation in an automobile for over a year. They claim that they can raise steam from a stone-cold boiler in from 20 to 50 seconds, and that the only manual operation involved in this process is the turning of a switch. The fuel is not vaporized, but is burned in a cold state, and burned completely. At the present time kerosene is being used but heavier fuels are available if desired.

The inventors insist that they have a boiler which will not prime, is non-explosive, will not crust up or scale, and can be forced to the limit. It has had five years of automobile use. The car will run a mile on the stored steam after the fire is cut off. They say they have learned how to burn fuel without sooting the spark plugs or boiler coils and without concentrating the heat on any single coil or on the refractory lining. All of the complicated automatic control devices have been eliminated, the steam gage controlling wholly the temperature and pressure, and keeping these uniform. The water pumps have no stuffing boxes, and run noiselessly, submerged in oil.

The boiler is of the continuous flow type, consisting of a conical frustum of coils connected in series so as to form a continuous tube through which the water fed in and the steam discharged out must pass. These coils are arranged one within the other about a central combustion chamber. Circulation of water through this boiler is dependent upon the water pump. The velocity of the steam through the coils approximates 450 feet per second. This high velocity, with the use of deflocculated graphite in the kerosene for lubricating the engine, does away with scale and deposit. The boiler has 72 square feet of heating surface and can produce 500 pounds of steam per hour.

The kerosene fuel is ignited cold by an electric spark. The spark-plug circuit is cut off automatically after two seconds by a switch operated by the kerosene gage. No pressure is carried on the fuel tank. When the fire is on, the fuel is pumped by a small electric motor which also runs the water pump and the air blower. The fuel passes through a very fine atomizing nozzle and is discharged in a fine spray at 35 pounds pressure, directed downward from the top of the boiler into the combustion chamber. This nozzle holds back the fuel until proper spraying pressure is reached. The air from the blower, it will be noted, has nothing to do with fuel atomizing, which depends solely upon pressure and upon the shape of the nozzle.

The combustion chamber is quite long, and is com-

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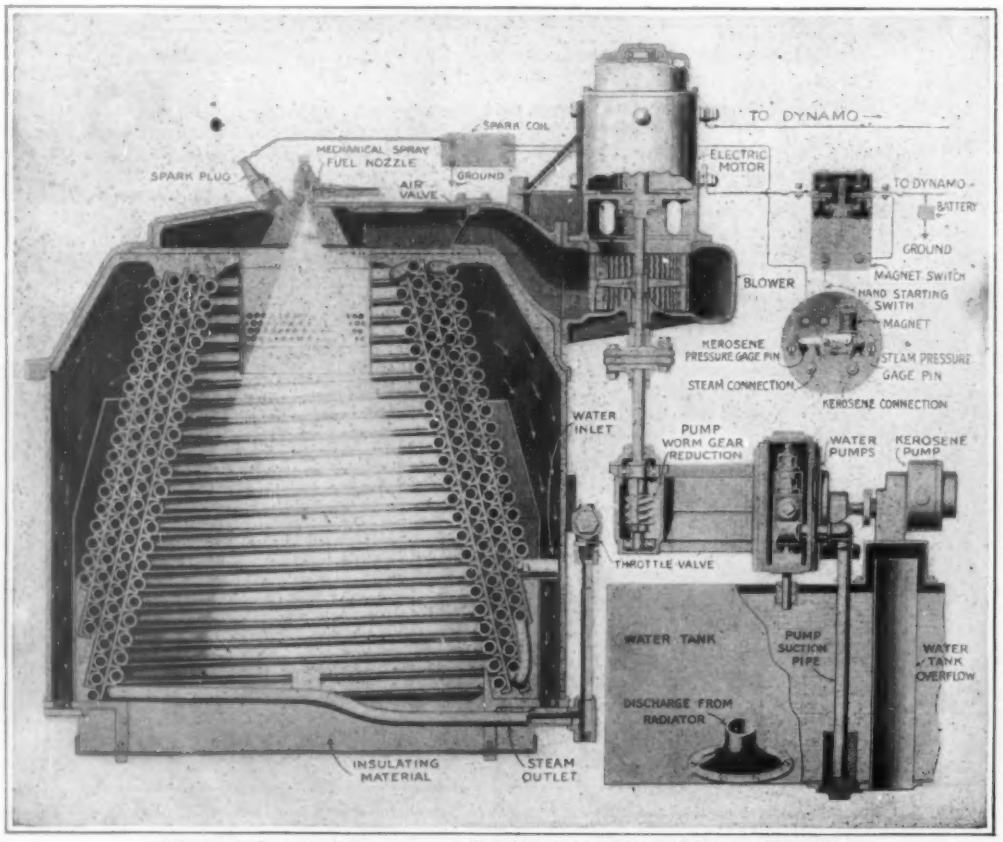

Schematic layout of the components of the latest steam-driven automobile

Melting Brass Electrically

By Raymond Francis Yates

METALLURGISTS have long tried to melt brass successfully within the electric furnace. Such a method of melting offers tremendous advantages over the more conventional fuel-heated furnaces The electric method effects a great saving of zinc and a product of high quality entirely free from oxygen and sulphur. Aside from this, the electric method also makes it possible to handle large charges.

It is only recently that a successful electric furnace for melting brass has been developed and put in operation. The development and perfection of what has become known as the rocking brass furnace must be credited to Dr. Gillett of the Bureau of Mines. Dr. Gillett and his associates conducted a series of experiments which extended over a period of five years. The perfection of a very successful furnace resulted from this experimentation. This furnace is rapidly replacing fuel-heated furnaces, and it may not be long before electrically produced brass will entirely replace the more crude product.

There are many advantages which determine the success of the electric furnace in the brass foundry. The most important qualifications required in any brass furnace, whether electrically- or fuel-heated, are speed of production, reliability and the capacity to produce a good quality of metal at a minimum cost, not only for maintenance and fuel, but for raw materials. The ability of a furnace to handle any alloy under various operating conditions is a very important factor which greatly contributes to successful operation.

The reliability of the electric brass furnace has been found to depend largely upon two things, *i. e.*, ease of control and simplicity of construction. Considering the service which an electric furnace of this type is required to render, the attainment of these features is not as easy as may be supposed at first thought. It has been found permissible to employ somewhat complicated control devices outside of the furnace providing that these devices are largely automatic and not exposed to the high heat. The interior of the furnace chamber must be as simple as possible; all the electric and refractory parts must be reduced to the simplest possible form. Dr. Gillett found that moving parts must be rugged, simple, and under absolute control. Refractory surfaces must be as smooth as possible and unbroken by corners, ledges or projections. These particular requirements are necessary owing to the intense heat of the furnace chamber and the constant rocking motion during operation which would cause great trouble with broken refractories and electrical short circuits if the foregoing features were ignored.

The electric furnace must be made to endure the abuse to which it will be subjected at the foundry. A furnace with a multiplicity of delicate parts which

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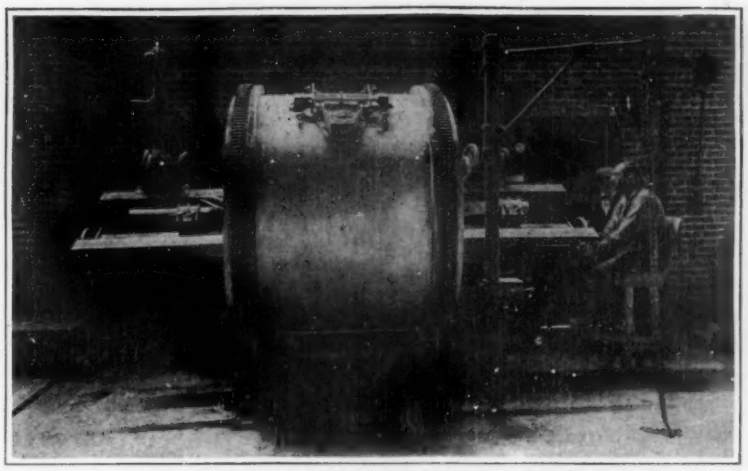
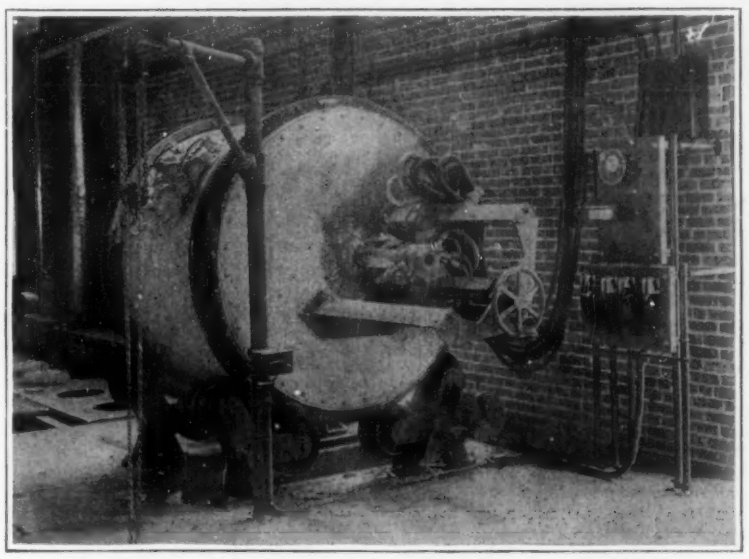


The rocking electric furnace for melting brass



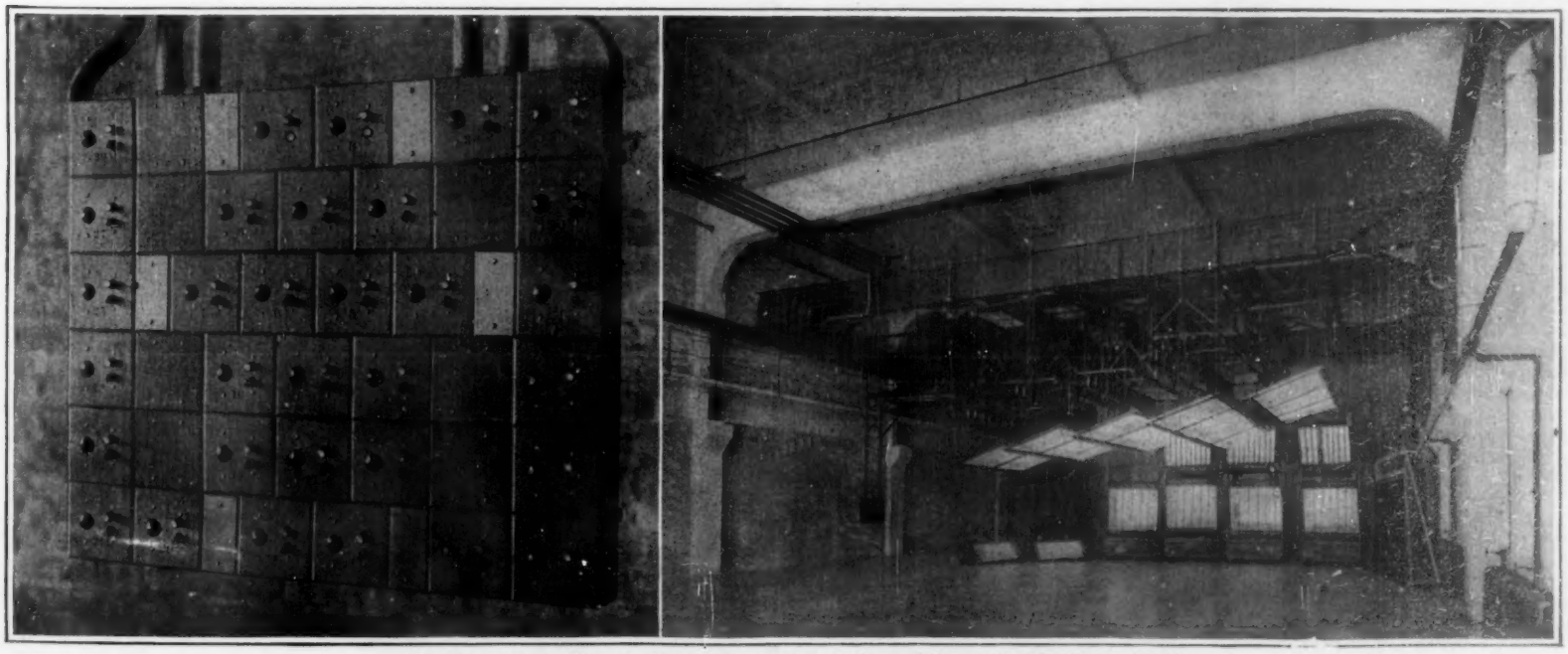
Another view of the furnace showing the rocking controls and the electrode feed wheel

The Artificial Daylight of Photoplay Land

LONG ago the motion-picture industry established itself on a twenty-four hour basis. That is to say, the pioneers were satisfied to carry out their work in broad daylight, when the weather favored motion-picture photography, and during inclement weather all operations were suspended. But that was when producers were not working on any definite schedule; they produced as much film as they could, with the full assurance that such film had a large market waiting for it. Then the industry got down to something like real business, and schedules were set into operation. So many reels had to be turned out every week, in order to meet certain programs; and the producers, no longer able to take their own time, were compelled to build studios and employ artificial lighting so as to go on with their work without regard for the weather.

Typical of the lighting equipment of most modern studios is that shown in the accompanying illustrations. Here are shown mercury-vapor lamps on overhead racks and floor stands, so as to give any kind of illumination desired. The mechanical arrangement of these lamps is interesting. It will be noted that the overhead racks are suspended from a steel-beam framework that travels along on the side rails, so as to bring the lamps over any part of the studio floor. It generally happens that the light is only required for a few minutes at a time, so that the same set of lamps can be used for an entire studio in this manner. The switches controlling the various lamp units are mounted on a panel at the lower end of a ladder-like arm which, being fastened to the trolley framework, moves along with the lamps.

Flaming arcs are employed in some studios in place of mercury-vapor tubes; indeed, flaming arcs were first employed in the art. While arcs are still used in some studios, the mercury-vapor tubes today are predominant for many reasons. The luminous element of the latter type of lamp is a luminescent arc, in a highly evacuated tube of glass, formed between a mercury cathode and an anode of mercury or other metal not attacked by it. The large output of actinic radiation from mercury-vapor lamps gives them special advantages in the fields of photography. Although the light from the mercury lamps is a ghastly green which is most unpleasant and distorts all color schemes, it is relatively comfortable for the actors and excellent from the photographic point of view.



Switchboard controlling the mercury-vapor tube units and the studio installation itself

Left: Reserve paper stocks at an Atlanta factory destroyed by ants. *Center:* Wooden floor after a visitation of the insects.
Right: All that the ants left of valuable maps and plans at the Washington Navy Yard.
Samples of the destructive work of the white ants

Steel and Stone Cannot Stop Them

The Amazing Ravages of the White Ant, which Extend Even Into Temperate Regions

By George H. Dacy

WHITE ants are opponents of the dictate, "What man has joined let no one pull asunder." Forty species of these pestiferous rogues which reside in the United States are prize demolishers of buildings, both old and new, and their contents. They have tunneled under the Federal Treasury at Washington D. C.; they have penetrated the vault room of the National Bureau of Engraving and Printing and destroyed valuable bond paper; they have irreparably damaged battleship plans at the Navy Yard; they destroyed the foundation of the Old National Museum; they have despoiled churches, office buildings, railroad stations as well as private residences, and have toppled over telegraph and telephone poles innumerable.

There is one and only one positive cure for the white ant evil and that is to erect ant-proof buildings which are adapted for the successful repulsion of all the onslaughts of these insidious invaders. In supposedly well-constructed stone and steel buildings, improperly built concrete floors are a fertile and favorable avenue for the admission of the ants. Usually a coarse grout of gravel, cinders and cement forms the base of such a floor. This base usually is permeated with holes of all sizes, sorts and descriptions. A solid layer of concrete about two inches in thickness generally is laid on top of the base. The mistake of laying wooden beams either 2 by 2 inches or 2 by 4 inches in size in this topping while it is still moist is made. These beams usually are bedded directly over the coarse bottom conglomerate. The wooden overlay or floor is then nailed to these beams. The result of such misconstruction is that the ants work their way up through the coarse grout and locate in the wood beams where ideal conditions are provided for their residence as they live principally on cellulose and like dark, moist locations. Ultimately they penetrate the wooden floor and never cease their activities—where their operations are unchecked—until the floor is destroyed.

Such control measures as spraying, fumigating and repairing the floors are futile as they only temporarily alleviate the difficulty. It is absolutely essential to prevent the original entrance of the ants through the floor of the new building. This can be accomplished by providing one or two inches of solid concrete between the coarse grout and the wooden floor. Furthermore an air space should be left between the concrete and the floor. Care also must be exercised in the construction of stone and steel buildings not to leave any cracks or crevices around pillars or posts which extend down through the concrete floor to the moist earth beneath, where the white ants love to live and whence they penetrate to the building above through any such crannies. All concrete floors should always be made absolutely tight to keep out the pests.

Recent tests conducted by the United States Bureau of Public Roads have demonstrated the value of mixing heavy, mineral, residual oil with Portland cement to form a mixture which is non-absorbent of moisture and hence is particularly well adapted for use in the construction of damp-proof, ant-repellant floors. Frame houses such as bungalows which have no cellar should be placed on stone or concrete foundations high enough above the ground so that the light and air can penetrate beneath. Where it is necessary to use wooden timbers instead of a permanent foundation such as is suggested, the beams should be thoroughly saturated with coal-tar creosote. Untreated beams should never be laid on the earth or imbedded in moist concrete, as such conditions promote rotting and infection with ants. An air space should always be left around all beams so as to permit of air circulation.

Where possible, always construct the foundations of buildings of concrete, stone or brick, including stone or steel pillars in the basement to support the floor above; make walls and floor in basements and cellars of concrete and lay such floors on a gravel base. Wherever wooden timbers are used always impregnate them with coal-tar creosote. Lay basement window sills and frames over concrete and never allow the woodwork to come in contact with the ground. Complete dryness of the foundation and basement walls and floors is an important means of rendering buildings safe from ant molestation.

Where white ants are established in buildings, it is essential to examine the foundation timbers and other basement woodwork in order, if possible, to ascertain the point of entrance and the severity of the damage. Immediately remove all the damaged wood and drench the ground with kerosene. Then replace the damaged wood with rock, concrete, brick or metal work or substitute for the foundation timbers other wooden beams saturated with coal-tar creosote. As white ants always require access to damp earth whence they build galleries of refuse and excrement to the point of attack, control is possible by shutting off the source of moisture so that the insects are not able to extend their galleries further and hence perish.

Usually in the spring or fall according to the variety, the winged adult ants swarm and migrate from the parent nests to form new colonies. Whenever one find ants swarming about any building he should immediately investigate and ascertain the extent of damage already wrought as the swarm is a sure sign of infestation. In addition to destroying the woodwork and frame of buildings the ants attack stored goods such as lumber, wooden ware, books, papers of all kinds, pasteboard, hospital bandages, fabrics, clothing, shoes and leather products, as well as all food products stored in damp basements where the ventilation is poor. Throughout Florida and California the white ants have damaged many fruit and nut trees as well as woodlands containing merchantable timber. The ants also prey on grain and truck crops such as corn, potatoes, cotton, sugar cane, rice and garden truck. In addition they cause large annual losses in nurseries, orchards, vineyards and greenhouses.

Books, papers and valuable documents should never be packed away in warm, unventilated chambers as such environments are ideal for the entrance and multiplication of white ants. The ants often are present in old buildings and are always waiting for some form of cellulose upon which to prey. However, insects infesting stored material soon leave or die out or can be killed by spreading damaged material in the sunlight or in an oven or outdoors during cold weather. Fruit and nut trees should be protected against scars near the base and against heart rot, while by burning diseased wood and refuse the orchards should be kept clean of trash and infection. Usually it is inadvisable to set out nursery stock or crops on land which has just been cleared. Deep fall plowing is efficient in eradicating the colonies of white ants which burrow through the soil. And above all, it should invariably be borne in mind, in any place where ants might be expected to congregate, that an ounce of prevention is vastly cheaper and more effective than many pounds of cure.

ALL sorts of tales come from tropical countries about the depredations of ants of various species. One of the favorites has to do with the troubles of the South African public service corporations which are unable to keep electric meters in service for any length of time because the ants cannot be prevented from getting in and eating up all the insulation. And this is but a sample of the troublesome feats of these insect pests. To us in our temperate climate it is often hard to believe that the nuisance can be as bad as it is painted; and it will, therefore, be somewhat of a surprise to many of us to learn that even here we are not free. Texas is as badly infested with ants as the average tropical community; and even as far north as Washington, Mr. Dacy tells us, their ravages present a problem for the building constructor.—THE EDITOR.

Better Light for Microscopy

By H. E. Howe

MUCH of the progress made in medicine, bacteriology and biology has been due to improved methods for lighting objects that are being examined under modern high-powered lenses. The microscope, an optical instrument, and its lenses are used so to direct the light rays that the desired images may be formed for examination. Many times it is the shadows cast by the object which we see and examine, as, for example, under the ultra-microscope. Ordinarily the light is reflected by a plane or concave mirror beneath the stage. In more efficient systems for higher magnifications different types of condensers are employed and for the spirochete a dark field illuminator is the desired thing.

When we begin to examine opaque objects our difficulties increase, for the higher power lenses come almost into contact with the object and it is no longer possible to throw light satisfactorily either in quantity or direction upon the object by mirrors or condensers held at the side. Invention provided the vertical illuminator whereby rays of light are admitted into the tube of the microscope, and by means of prisms, mirrors or unsilvered reflectors, are thrown through the lens upon the object which is thus examined by reflected light instead of transmitted light.

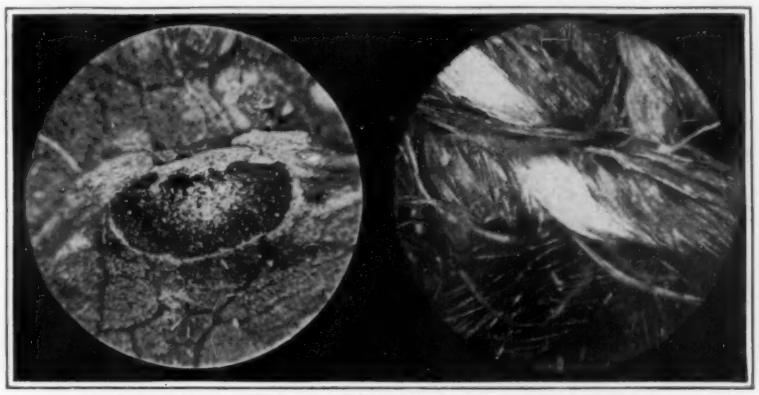
There are many forms of vertical illuminators just as there are several forms of illuminators provided with suitable filters and screens to produce light of daylight or special quality. A recent invention of Prof. Alexander Silverman of the University of Pittsburgh appears to fill a want which has long existed.

This invention consists of a quarter-inch-diameter glass tube containing a single tungsten filament and bent into a circle. This lamp is supported by a holder comprised of three fingers which clamp it to the objective of the microscope. The lamp is silvered in such a way that the light is thrown down upon the object from the circular source.

This lamp is illustrated, both alone and attached to a microscope objective so that when the objective is focused the source of illumination travels with it, the lamp and its mounting being of such light weight that no burden is imposed upon the mechanism of the focusing device. The rheostat is also shown in this illustration. The lamp operates on 0.9 amperes and 13 volts for visual work or at 1.01 amperes and 18 volts for photographic work. This change in electromotive force is quickly accomplished by means of switches and contacts provided on the rheostat. The

(Continued on page 236)

A 75-horse-power California tractor plowing the difficult soil of Hawaii



Left: A typical plant rust. *Right:* The structure of a bit of cloth

Photomicrographs taken with the aid of the annular lamp

Conquering the Stubborn Soil

By H. A. Crafts

THE two great staples of Hawaiian agriculture are cane sugar and pineapples. The treatment of the soil for the production of these commodities is a serious problem, by reason of the refractory nature of the soil. The three principal islands of the Hawaiian group are Hawaii, Oahu and Maui. The soil of the island of Oahu is fairly tractable, but that of the island of Hawaii is a different proposition, It is of a volcanic formation, red in color, and contains in its natural condition a large quantity of sizable boulders. On this island are many large sugar cane plantations and the expense of subduing the soil is comparatively excessive.

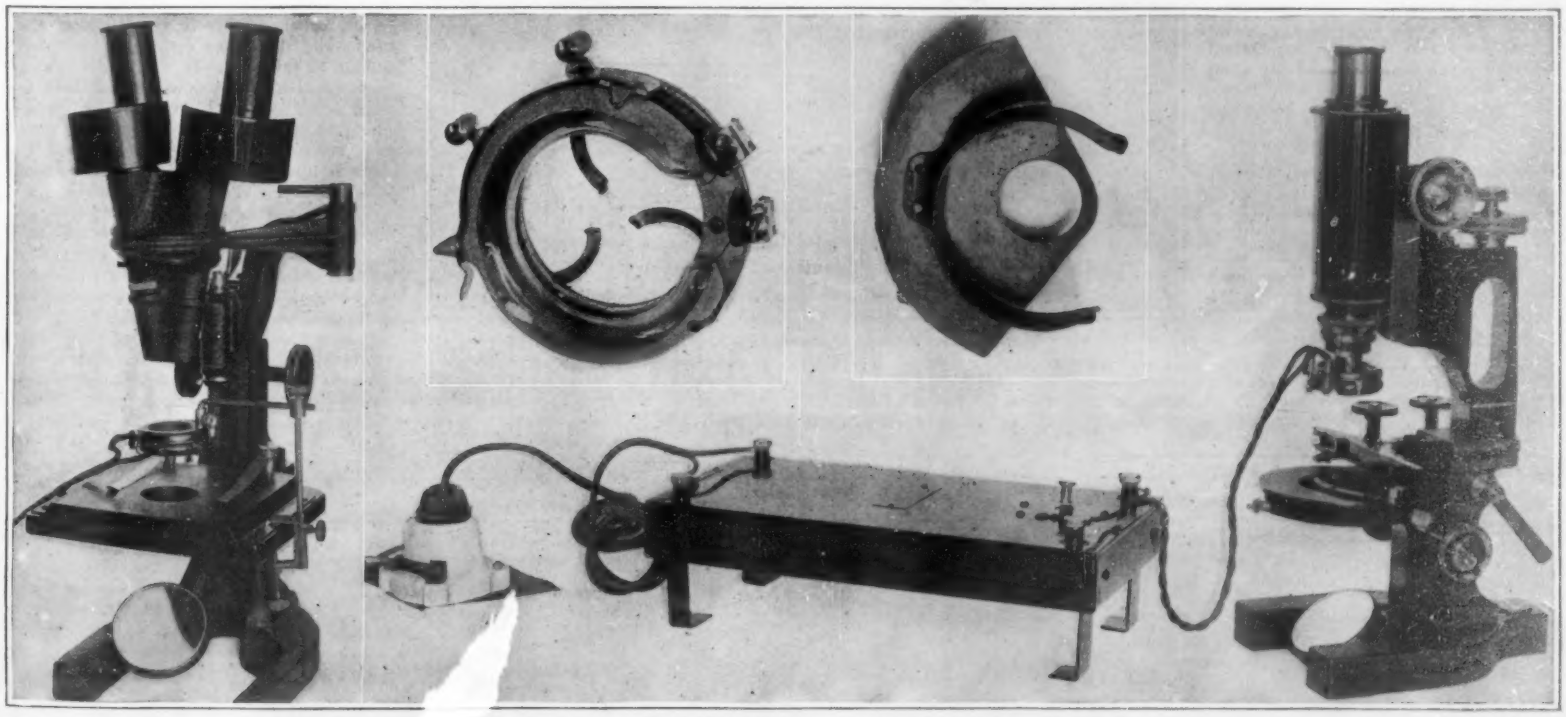
The bulk of the heavy plowing has been done by the so-called Fowler method, an English invention. This method involves the use of huge plows pulled from side to side of a cultivated field by means of endless cables and stationary engines. These big plows are run to a depth of twenty-four inches, breaking up the hard pan and preparing the land for the employment of lighter machinery.

Another hard feature of the Hawaiian soil is its failure to scour the plows as they are pulled along. Under these conditions it is necessary in plowing to have men, armed with picks, to accompany the plow in its progress across the field, and when it becomes clogged with earth, clean the dirt off the mold board as it is lifted from the furrow.

But the introduction of American farm tractors five years ago has revolutionized agricultural methods in the Hawaiian islands. While the Fowler system is still used in the breaking up of native sod, the farm tractor does the rest, such as mold-boarding, disking, harrowing, etc.

The mold-board plow used on the cane plantations is a large affair, double mold-boarded and four feet wide. This implement plows a double furrow from 18 to 24 inches deep, and in the bottom of this furrow the cane is planted, and water run through it for irrigation.

On the island of Oahu are located several very large pineapple plantations. The soil of this island being more tractable, level and free from boulders, the farm tractor is able to negotiate it in all its phases.



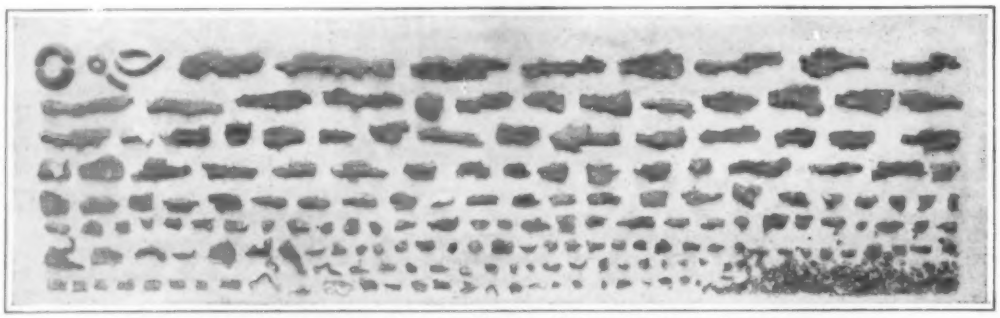
The large view at the right shows, attached to a microscope, the annular light-bulb which is pictured in detail in the left-hand insert, above. At the left is shown the same lamp in use with a binocular microscope, with the aid of a clamp; and the right-hand insert illustrates a shutter that can be used to cut off the light from a part of the field when desired

A new lamp, of ring shape, which gives an illumination of the microscopic field that has never before been possible

Firing Shell Into a Concrete Tank

The Experimental Water Butt at the Aberdeen Proving Ground of the United States Army

By Herbert T. Wade, Captain O. R. C., U. S. A.



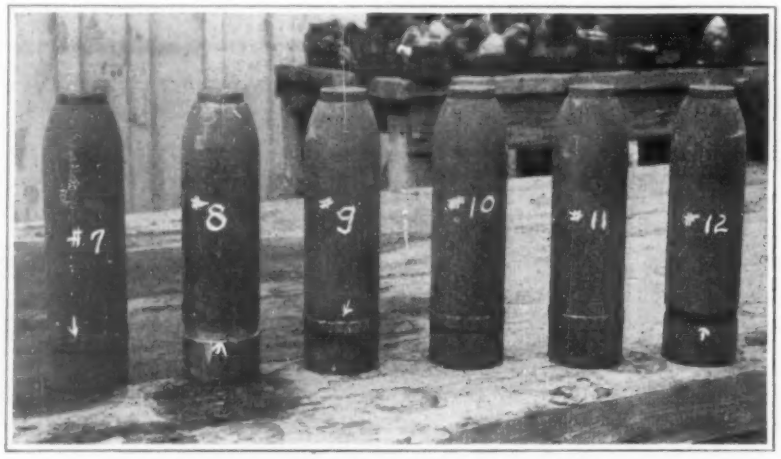
Results of the fragmentation of a 75-millimeter high-explosive shell in the water butt

IN testing a shell the usual practice is to fire it on a special range so that its burst will take place over or on a field of sand, where the fragments may be located and collected for study. In connection with war tests carried on at Aberdeen it seemed desirous to employ a large tank filled with water, into which the shell might be fired and its behavior studied, including the effect and results of its burst. Such a method, if successful, could be carried on at proving grounds equipped for certain tests, but not necessarily supplied with sand areas such as are found at Aberdeen or Sandy Hook. Accordingly, a tank of concrete of the general shape and dimensions indicated in the drawing, was built at Aberdeen, and here were made a number of tests.

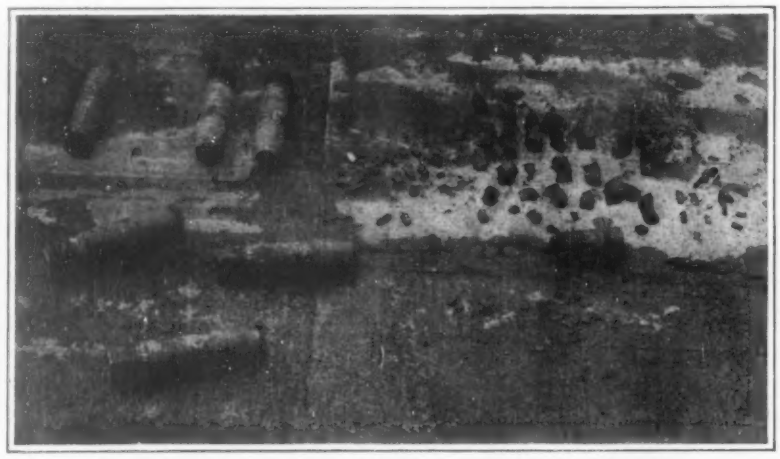
The object of these tests was to determine such items of importance as whether shell fired for subsequent recovery into a water butt at, say, 12 per cent excess powder pressure would upset on impact with water: what was the least angle of depression that could be used without causing the shell to ricochet or strike the far side of the water butt wall; what would be the depth of penetration upon firing; high explosive shell fitted with disks on the nose; and what would the path of the shell be through the water at various angles. For the last named problem, screens were to be placed at various distances from the muzzle of the gun, and the perforation of these screens would indicate the path of the projectile. Another question to be answered was the effect of a shell being fired through a pipe so as to give a normal impact on the water surface, and the effect of the shell at an acute angle to the water. Other items on which information was sought were the effect of firing shell into the water butt at high pressures and high muzzle velocities; the effect of high explosive shell detonation for fragmentation upon the construction of the water butt itself; the most satisfactory method of recovering the fragments of the shell from the water; and finally, how large-calibre, high-explosive shells could be fired in a water butt of the nature described.

The general nature and dimensions of the water butt are shown in the accompanying diagram. When filled to the desired level, approximately 426,000 gallons of water are required, this water being supplied from a 6-inch water main, with a secondary supply tank 4 feet from the top of the tank. The tank is drained through a 12-inch cast iron pipe, and is so arranged that it can be used as a reserve water supply for fire or other emergency.

A float built in three sections and arranged so as to be anchored in any position on the water surface, carries 6 under water screens which were fitted with ¾-inch mesh chicken wire and ¼-inch mesh galvanized iron wire fly screening. These screens were held in a perpendicular position while in the water, and the position of the float naturally depended on the line of fire of the gun and the angle of depression.



Mark I common steel shell with 1¾-inch steel plaquettes



View showing condition of shell, slugs and plaquettes after firing

When the gun was fired into pipes filled with water, both heavy cast iron 14-inch pipe and galvanized iron 18-inch pipe were employed with counter weights to sink one end below water level, and a framework for the pipe support and adjustment for various angles of depression and change in the line of fire.

The gun used in these tests was a British 75 mm. field gun, with a special arrangement on the platform where it was handled to permit of the desired amount of depression and to prevent movement at the counter recoil. Common steel shell and cast iron slugs were used in the tests, the shell being loaded with sand to standard weight and fitted with plaquettes or nose disks. To recover the fragments of the shells tarpaulins were laid along the bottom of the tank, while screen skips made out of ¼-inch mesh galvanized wire operated from both sides of the tank by ropes and an oyster rake of the standard type were employed. In the course of the tests both slugs and shells were fired through the pipes, shells were fired without the pipe, and a shell was fired for purposes of fragmentation. The result of the various experiments demonstrated that shell fired into the water butt for recovery at excess powder pressures would not upset on impact with the water only, and that if the shell velocity is completely reduced before the shell strikes the bottom or end of the tank, a fair test can be made on the shell for recovery. Such a shell should be fitted with steel plugs the same diameter as the shell mouth or with dummy fuses, as the edges of the disks or plaquettes which figure in the experiments are stripped and the shell upset as shown in the photograph. It was also found that decreasing the angle of depression too much throws the point of the shell penetration in the water too near the center of the tank mouth, thus not leaving sufficient water for the complete reduction of the shell velocity before striking either end or side of the tank. It was found that a depression of 10° was the best angle to use. At the excess powder pressures as employed in the test of the 75 mm. common steel shell, 60 feet of water was traversed before the shell energy was lost, and approximately 75 feet of water was necessary for a complete retardation of the projectile. Curves showing the path of the projectile in the water were computed from a number of experiments and the simple diagram below shows a single instance with reference to the screens.

It was also concluded from the experiments that when the shells were fired through pipes for normal water impact, they would not be subjected to any uneven forces when fitted

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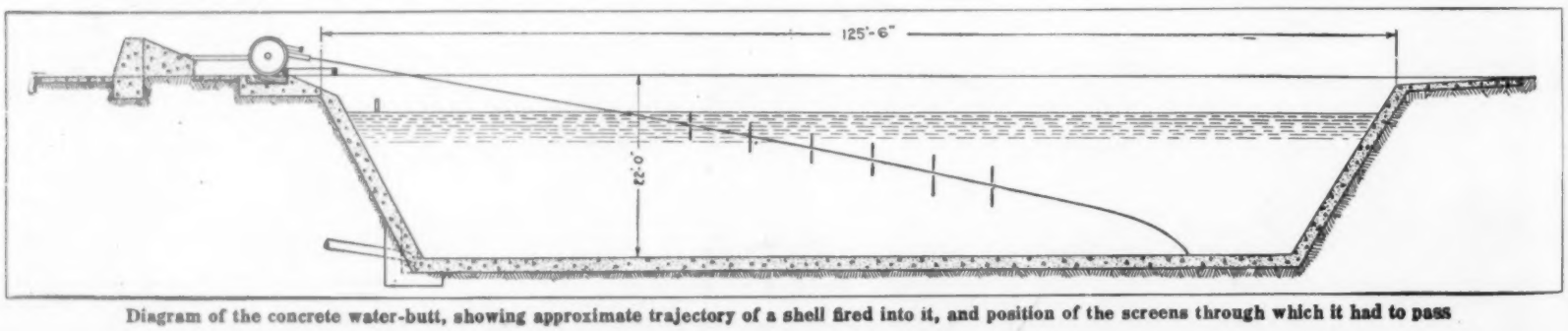

Diagram of the concrete water-butt, showing approximate trajectory of a shell fired into it, and position of the screens through which it had to pass

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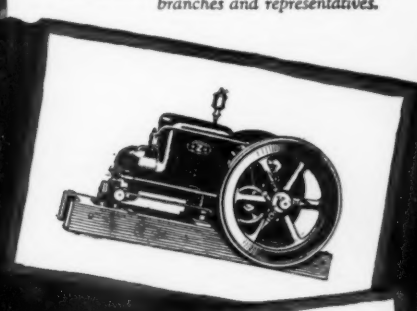
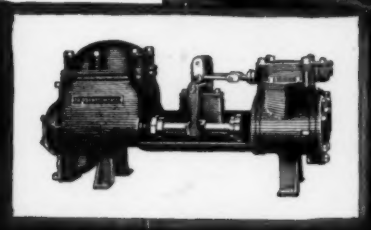
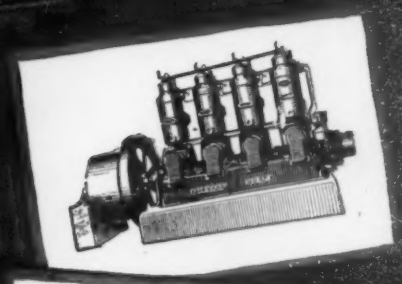
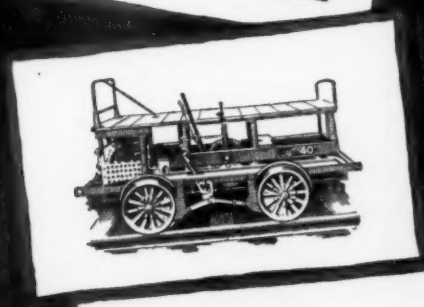
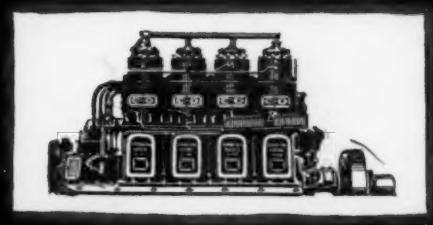
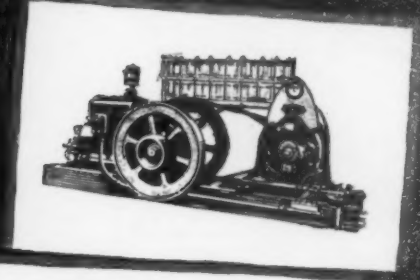
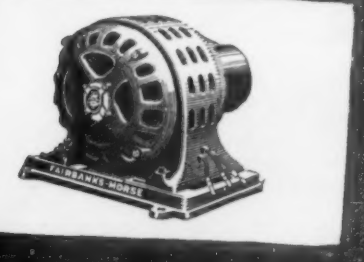









Inventions New and Interesting

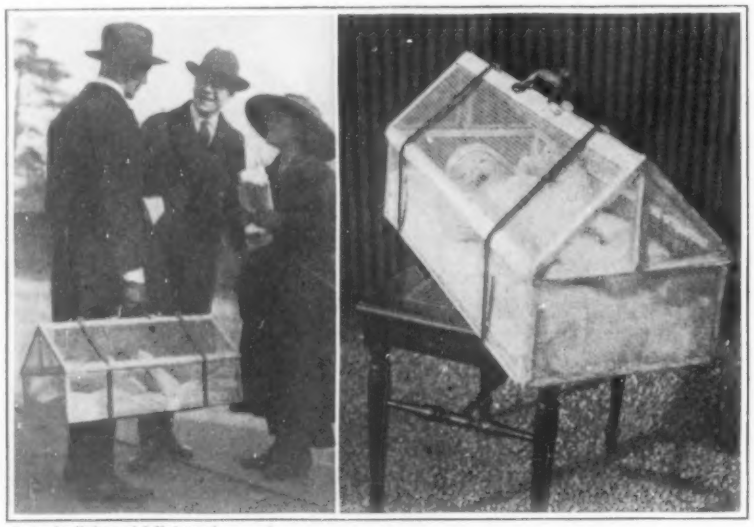
A Department Devoted to Pioneer Work in the Arts

A Satchel-Pullman for the Travelling Baby

NECESSITY is certainly the mother of invention. Every day the truth of that dictum becomes more obvious. And so we come down to the story of little Jane Telaak who, when she arrived in this world, became quite a problem to her parents. Let us hasten to explain that her parents are vaudeville performers, and as such they are compelled by contract to travel all over the country.

The father of the little girl, Bill Telaak, hit upon the novel idea of a satchel-pullman. He had a satchel constructed of heavy wire mesh and measuring 30 inches long, 18 inches wide, and 20 inches high. The satchel weighs only 22 ounces complete, with its featherweight mattress, pillow, blankets and so on. On a rainy day the satchel is provided with a rubber cover.

And thanks to this display of inventiveness on the part of the father, Baby Telaak travels along with her parents in comfort—and gratis.



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Two views of the satchel-pullman used by itinerant parents

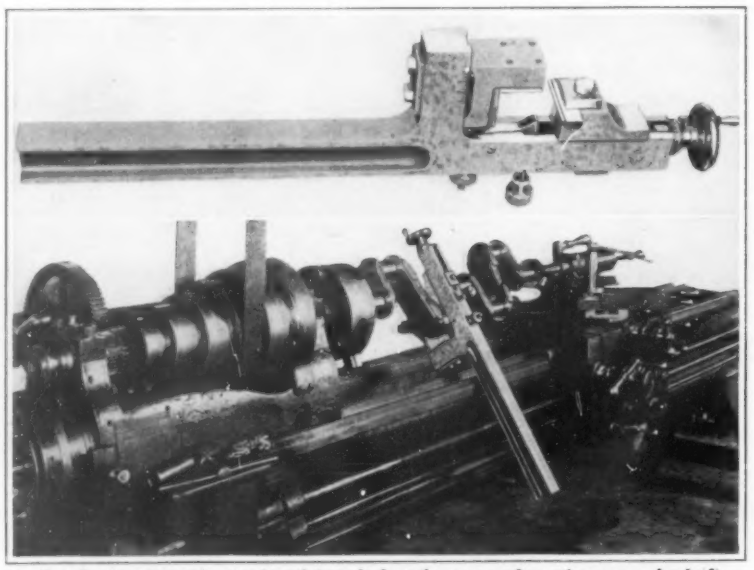
A Crank Pin Re-turning Tool

IT has remained for Alex Weber, a master mechanic of Los Angeles, Cal., to invent a most ingenious tool for expediting work on engine crankshafts. It will be noted in the accompanying views of this device, that it is a crank pin returning tool and works on any ordinary lathe. One view shows the tool in operation on a four-throw crankshaft. The engine crankshaft is held between centers. All four pins are turned true and finished in one setting in 30 minutes to an hour on the average tractor crankshaft. The shaft is rotated very slowly and the tool rides around with the pin, the handle at all times resting on the bed of the lathe.

At the top of the tool will be noticed the hand wheel, which feeds the cutting tool into the pin. This wheel has a dial below it which is graduated into half thousandths (0.0005) of an inch. This dial can be locked by means of a set screw, in any position, thus making it easy to turn all pins to exactly the same size.

The pin is firmly held in place by three supports. The cutting tool is a forming tool, the width of the pin. It starts cutting on the surface worn least and gives an absolutely round pin to 0.0005 inch. There is no filing, no offsetting, no jigs, and it is claimed that it does as accurate work as the most expensive crankshaft grinders.

The usual expensive grinders are out of reach of the ordinary engine repair shop. On the other hand, the offset jig method is not very accurate or satisfactory. So the present device, if it does all that is claimed for it, has a broad field of usefulness before it.

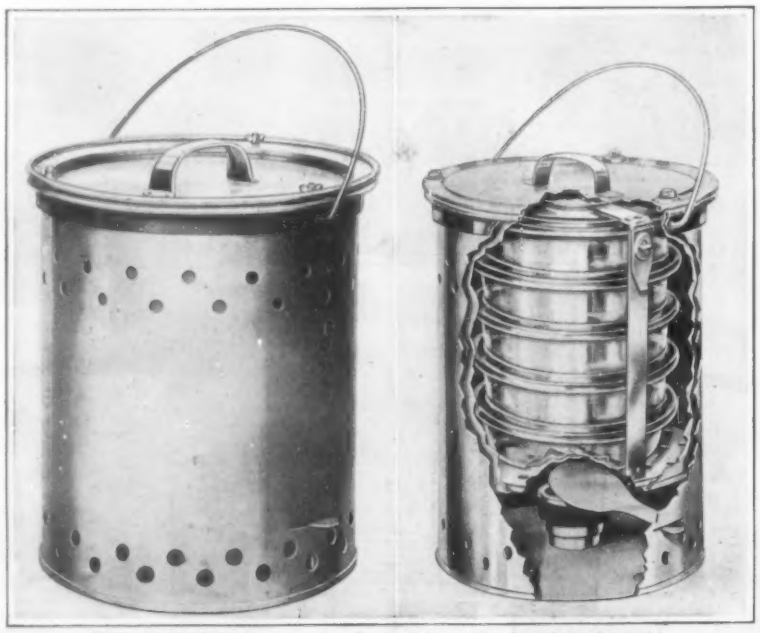


Crank pin re-turning tool and how it functions on a four-throw crank shaft

Food Carriers for Serving Long-Distance Meals

THE cooking problem has been successfully solved in many American homes. Now when the cook decides to quit after a more or less desperate attempt to assume the directon of the household, the housewife need not be plunged into the depths of despair. A telephone call to the nearest community kitchen assures three excellent and piping hot meals delivered to the door every day; and worry about help, marketing, choice of food and so on, become mere myths of the past.

There are something like thirty-two community kitchens now in operation in the United States alone. While they all do a thriving trade, since the idea has met with instant and wide favor, they have been seriously handicapped by not having the proper kind of container in which to deliver their meals. The big problem has been in the delivery of meals. Most families order their meals for about the same time, and since they are scattered over quite an area, it stands to reason that some of the meals are delivered an hour or more before they are called for by the patron. The solution of the problem, obviously, has been to find some form of container that would maintain the food at the proper heat for several hours.



Exterior and broken-away views of the self-heated food carrier

It has remained for Mr. I. C. Popper of New York City, to invent a food carrier that appears to solve the problem of the community kitchen. His container, which is shown in the two accompanying views, enables the delivery of meals to start say from one to two hours before the meals are wanted by the patrons. Thus one driver can cover a long route, and the delivery costs are materially reduced. The food, placed in the various dishes of the container, is kept hot by the solidified alcohol burner, which is lit by the driver when he leaves the container on the customer's front porch.

At the community kitchen the cook fills the various glass dishes of the food container and places them in the holder. A quart of water is poured into the large can and the dishes, locked in the holder, are lowered into the bath, and the cover clamped on. The entire unit is now placed in the outer container which can be carried by means of the bale handle. A fresh can of solidified alcohol is placed in the compartment below, and the meal is ready for its journey. The paddle-like member serves to put out the alcohol flame when the meal is ready to be served.

Latest Patent Decisions

Interfering Claims:—The patent in suit deals with a complicated biscuit-cutting machine. Speed and avoidance of waste are the chief objects. The patent citations contain many illustrations of machines designed to accomplish this result. It is with the operation of the pan carrier that the patent in suit deals. The pan carrier advances each pan at a regular rate and receives the successively dropped rows of biscuits until the pan is full. A momentarily accelerated movement of the pan carrier then occurs so that the succeeding pan is brought into position to receive the succeeding row of biscuits. It is highly important that the skipping, as this acceleration of motion is termed, should occur at the right moment otherwise there will be "crippled" biscuits, resulting in waste.

This is an appeal from the District Court of the United States. Suit by Thomas L. Green *et al* against the Taggert Baking Co. for infringement of patent. A decree was entered for complainants and the defendant appeals. Affirmed, holding as a matter of law that the claims inserted after the original application, in reference to the Green patent, on request of examiner to show interference, were within the drawings and specifications of the original application, and that the Green patent for a biscuit cutter, especially relating to pan carrier with automatic skip, which could be adjusted without stopping the machine, is valid as disclosing invention.—*Taggert Baking Co. v. Green, et al.—U. S. C. C. A. of Ind.*

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"PERFORMANCE COUNTS"

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

NECKTIE.—H. J. SCHOTTELKORB, Pasco, Wash. An object of the invention is to provide a necktie which may be adjusted by the wearer to present the appearance of a bow tie without requiring any special skill on the part of the wearer or any assistance of another. In fixing the tie the wearer first

A PERSPECTIVE VIEW, THE TYING ENDS BEING FOLDED AND THE CENTRAL BAND IN POSITION

adjusts the length of the neckband. The center band is placed over the tying end, the long tying end folded over on itself to simulate a bow and the folds held in position by an invisible elastic band.

Of Interest to Farmers

PLOW.—T. A. BOON, Ashville, Ohio. The invention relates generally to plows, and is more particularly a plow attachment for gang plows, to supply an extra plow for use in the corners of fields, the main object being to eliminate corner trouble in tractor plowing and by so doing, to encourage the use of tractors on the farm. The extra blade attachment is not used in plowing the sides of a field but simply run into a previously made furrow at one side, its function being reserved for the corners.

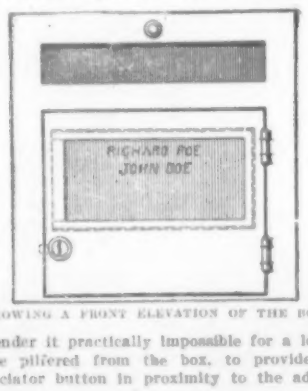
DEVICE TO ASSIST COWS IN CALVING.—C. SPRUYT, Coleman, Wis. The invention relates to a device for affording assistance to animals in the act of delivering their young, and more particularly intended for use with cows. The general object is to provide a device adapted to be expeditiously positioned and adjusted for use, as well as unfailingly operated to carry out its purpose without danger or injury to the cow or its calf.

Of General Interest

AUXILIARY ATTACHABLE FOR RAZOR STROPS.—C. H. RICHARDSON, c/o J. B. Williams & Son, Dover, N. H. This invention relates to razor strops of the flexible swinging type as used by barbers. The main object is to provide a normally convexed surface adapted for instant connection with and disconnection from a strop whereby one support may be used upon each of a plurality of strops, or for instance with the canvas side at one moment and the leather side the next. The support yields to the pressure of a razor into an approximately flat state.

HIGH VELOCITY GUN.—W. MEINERSMANN, c/o Metal and Thermit Corp., Chrome, N. J. One of the objects of the invention is to increase the velocity of the projectile without materially increasing the pressure within the gun, thereby avoiding undue pressure on the walls of the gun and preventing probable rupture. Another object is the provision of a firing device for exploding the charge, which firing device is carried by the breech-block and is automatically operated when the latter reaches a predetermined point in its forward movement.

LETTER BOX.—W. E. DREELAND, Aptmt. 2D, 428 W. 204 St., New York, N. Y. The invention relates to private letter boxes, and has particular reference to useful features of construction as follows, the provision of means



SHOWING A FRONT ELEVATION OF THE BOX

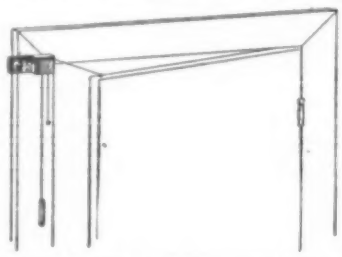
to render it practically impossible for a letter to be pilfered from the box, to provide an enunciator button in proximity to the admission slot, to provide an unusually large name card, and finally to provide a front door which will prevent a view into the interior of the box.

LIBRARY TABLE.—G. A. SPIES, Lowell, Ohio. The invention relates to book shelf construction for tables. The book shelves are mounted to slide inwardly beneath the table top to retracted and substantially concealed position, and outwardly to projecting position to provide convenient access to the books thereupon. A roll top or curtain is provided which is arranged to move downwardly over the front of the book shelf for keeping out the dust.

SLIPPER HOLDER.—J. J. LECKEY, 1900 Pacific St., Brooklyn N. Y. The primary object of the invention is to provide means for retaining slippers when not in use. A further object is to provide a device by means of which the slippers or shoes may be disengaged from the feet and engaged with the support by the insertion of the feet into engagement with the slipper-supporting means.

VANITY PUFF.—B. H. KRUEGER, 10 Stephenson Blvd., New Rochelle, N. Y. It is the primary object of this invention to secure the manipulating loop to the puff-body in such a manner that when the same is not interfered with it will occupy a vertical position in which it may be readily grasped by the fingers of the operator, at the same time the invention provides an effective means for securing the loop to the puff.

DOOR ALARM.—T. NAGAYAMA, Hilo, Territory of Hawaii. The invention relates to audible alarms adapted for disposition upon door frames, and connected with the door whereby upon opening the door from outside



PERSPECTIVE VIEW OF DOOR FRAME AND DOOR SHOWING DEVICE APPLIED.

an alarm will be sounded, means being provided whereby upon opening the door from the interior of the room or store, a person passing out may render the alarm inoperative.

LOCK FOR HANDBAGS.—W. T. GOLDSMITH, 481 Washington St., Newark, N. J. The object of the invention is to provide a bag frame comprising in combination with a plurality of hinged closure members, a rigid hook carried by one of the hinged closure members, a spring carried by the other and adapted to engage with said hook to maintain the closure members in closed relation, an operating button carried by the spring and projecting through the closure member for disengaging the spring and hook to permit of opening the closure members.

Hardware and Tools

FILE HOLDER.—W. D. IVY, 302 So. Dudley St., Memphis, Tenn. The object of the invention is to provide a device especially adapted for holding the files used in filing machines for gin, linter and like machines. The holder comprises a shank having at one end laterally extending flanges forming a channel for receiving a file, and at the other end the shank being thickened on the back and having a longitudinally extending groove.

LIFTING CLAMP OR DOG.—A. G. STRATHERN, address W. E. Voltz, 6 Church St., New York, N. Y. The invention relates to lifting clamps or dogs of the type which are intended to be used in pairs for lifting plates and other general flat subjects on the flat, that is horizontally, by gripping or biting them at the two ends by top and bottom pressure. The characteristics of the clamp is that the bite of the upper member on the surface of the plate is beyond, or inward of, the bite of the lower member on the under surface of the plate.

TIP ATTACHING IMPLEMENT.—A. YOUDELMAN, 2257 3rd Ave., New York, N. Y. The object of the invention is to provide a hand tool more especially designed for attaching metallic tips to the ends of strings such as are used for lacing shoes, corsets and like articles, and arranged to enable the user to rapidly replace a worn out or broken tip by a new one without requiring undue physical exertion. The same inventor has been granted a second patent of a similar nature, but which is exceedingly simple in construction and inexpensive to manufacture.

Heating and Lighting

STOVE.—S. A. JONES, R. No. 2, Box 205, Bessemer, Ala. The invention relates to a convertible stove and has for its object to provide a stove capable of being arranged within a grate or fireplace, being seated upon the hearth in the opening of the grate or fireplace, and arranged to provide an open or a closed fire.

Machines and Mechanical Devices

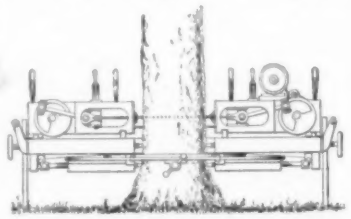
SHAFTLESS PROPELLER.—I. HELGUERA, 10 So. Broad St., Trenton, N. J. This invention relates to marine propulsion and has particular reference to a propelling device for use in connection with boats or ships. Among the objects of the invention is to so construct a hull and its propelling means as to secure the greatest efficiency and economy in operation because of the reduction of the tendency to create waves and eddies, and thus to increase the stability of the ship and its safety against mines and torpedoes.

STOP-MOTION.—G. H. DUBRAE, address Wm. Skinner and Sons, Holyoke, Mass. The invention relates to warping machines; its object is to provide a stop motion for textile machines arranged to actuate the driving clutch on the main shaft whenever any one of the yarns break. A further object is to provide a stop motion which is simple and exceedingly sensitive to unfailingly stop motion on the breaking of a yarn. Another object is to permit the attendant to stop or start the machine from either side.

AIR PUMP.—V. L. SNYDER, Douglas, Okla. This invention has for its object to provide means for use in connection with double cylinder air pumps for converting them into pumps of the single cylinder type. No special tools are required for converting the double pump into the single pump and no particular skill.

SPROCKET CONVEYOR.—R. J. RILEY, Livermore Falls, Maine. The object of the invention is to provide a conveyer having a sprocket with an annular channel, having flaring sides for receiving a cable and with openings spaced apart and cut from its periphery inwardly beyond the bed of the annular channel so that buttons secured to a cable may drop into the openings while the cable will fit snugly in the channel.

SAWING MACHINE.—E. L. DEAN, Shrewsbury Mass. Among the principal objects of the invention are to provide a machine readily adjustable to various working positions to permit its use in felling and trimming timber,



A FRONT ELEVATION SHOWING THE INVENTION IN PLACE FOR OPERATION

to provide means for handling the machine when adjusting the same, to reduce the manpower necessary, to reduce the risks in the field of timber and to facilitate the shipment of timber from the forest to the mill.

Prime Movers and Their Accessories

INTERNAL-COMBUSTION ENGINE.—J. O. HULSE, 1222 Lyon St., Flint, Mich. Among the objects of the invention is to provide a sub-piston operating within the combustion chamber to retain the same clean and free from carbon; to provide means to move the sub-piston longitudinally, and to impart a rotary movement to the same upon its upstroke; to provide means whereby the sub-piston draws in the charge or mixture for the entire length of the cylinder, and completely expels the products of combustion from the cylinder.

Railways and Their Accessories

SPIKE PULLER.—A. MCLAIN, 322 1st St., Carnegie, Pa. This invention particularly relates to a device for extracting spikes driven into railroad ties to secure tracks to such ties. An object is to provide a construction which will make it possible to easily engage the head of a spike, even though such head should be driven flush with a retaining medium. A further object is to provide a puller which will extract spikes by exerting upon them a pull in a substantially opposite direction from the force used to embed them.

AIR COUPLING.—C. R. SCHRADER, 1446 Market St., Akron, Ohio. The invention relates particularly to air couplers adapted for, and capable of, automatic action, especially in the coupling of railway cars, and constructed so as to not only do away with air hose between cars, but to effect an automatic venting of the train pipe in case of wreck, derailment, or any other cases of accidental disconnection of the couplers.

Pertaining to Vehicles

RUNNER ATTACHMENT FOR WHEELED VEHICLES.—C. GREBENSTEIN, 558 E. 2nd St., Brooklyn, N. Y. The object of the invention is to provide a runner attachment for converting a baby carriage or other wheeled vehicles into sleighs to allow of conveniently running such vehicles over snow or ice-covered roadways. Another object is to provide a runner attachment which can be quickly placed in position and securely fastened to the front and rear wheels of the vehicle.

SHOCK ABSORBER.—G. B. REID, 615 Boren Ave. (Apt. 32), Seattle, Wash. This invention has for its object to provide a device of the character specified, especially adapted for cushioning the rebound of vehicle bodies under reaction of the springs; to accomplish this a simple, inexpensive but efficient shock absorber in the form of a coil spring and strap is provided at each corner of the vehicle.

SPRING SUSPENSION FOR VEHICLE.—S. T. GOODWIN, 1400 University Ave., Bronx, N. Y. The invention relates to spring suspensions and has reference more particularly to the provision of a coil spring between a cantaliver spring and the bearing of the frame. The coil spring is primarily intended for taking up the light shocks which do not affect the cantalever spring.

VEHICLE-WHEEL TIRE.—C. E. P. JULIEN, Paris, France. The object of the invention is to provide a wheel tire adapted to run on both hard and soft ground. The tire comprising a plain tread having permanent ground-grpping projections and adapted to be fitted with removable additional ground-gripping studs giving increased adhesion in case of tractors and agricultural machines.

VALVE GRINDER.—F. J. DERIFIELD, Boise, Idaho. The invention relates to valve grinders for automobiles. The principal object is to provide a grinder which in operation will effect an oscillatory motion of the valves which are being ground and which, at the same time will effect a continuous rotary motion of the valve cases or cages in one direction only, thus effecting an equal grinding of the surfaces at all points around the valve seat.

TIRE ALARM.—F. H. VALITON, Deer Lodge, Mont. The general object of this invention is to promote a device for giving an audible signal when a leak occurs in a pneumatic tire, to provide a device which is simple, having few parts, and those of such form that they may be readily assembled, and which may be attached to and coact with the regular valve stem commonly employed to inflate the tire.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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TRADE MARK

Our Deepest Wells

(*Continued from page 214*)

the Lake bore is the deepest temperature record yet made.

It will be noticed that these readings show variations, which plainly indicate that other circumstances than depth figure in determining the measure of local heat at any point below the earth's surface. This emphasizes the importance of taking temperatures with all possible exactness; and it was to this end that the expert of the U. S. Geological Survey devised his special apparatus. We are told authoritatively that in any of the three deep wells here, which have been under consideration, the boiling point would be reached at a penetration of 10,000 feet.

No one now knows what is the source of the enormous quantity of heat stored away in the bowels of the earth. Some scientists believe it to be due to the disintegration of radium in subterranean rocks; others argue that the earth is a cooling globe radiating heat developed during condensation from the original nebula; while there are those who claim that chemical reactions are responsible. Be this as it may, it may yet be of the utmost importance to us to evolve ways to draw upon this potential energy at will; and the study of the temperatures of very deep wells, and the positive knowledge obtained from these borings of the dip and the successive geological formations lying below our feet are calculated to help us to this end.

In his work in this direction, Mr. Van Orstrand has used two types of temperature registering mediums—so called maximum thermometers employing a mercury column, and electrical resistance thermometers wherein the deflection of the needle of a Wheatstone bridge indicated the flow of current and, accordingly, the temperature of the resistance element lowered into the well. The trouble with the mercury thermometer is the error that may be introduced by the instrument being jarred during the passage surfaceward, thus shaking down the column of mercury and leading to erroneous records when brought up. Again, the mercury thermometer has to be exposed for an hour or so in order to obtain the desired result at the chosen depth.

The electrical resistance thermometer, on the other hand, has all of its registering apparatus above ground and it is necessary to lower only the electric circuit. Up to a depth of 3,000 feet, Mr. Van Orstrand's field work has demonstrated the superiority of the electrical equipment. Perfect insulation is necessary, and petroleum ultimately dissolves all of the usual insulating compounds. Therefore, beyond 4,500 feet this physical geologist would have recourse to two sets of three maximum thermometers—one set having the mercury bulbs inverted so that the mercury could not be jarred back into the bulb by any blows transmitted to it on the journey surfaceward. In this way a check would be afforded which would reduce to a considerable measure the likelihood of error.

What About Our Commercial Aviation?

(*Continued from page 215*)

great distance separates the subject and his objective, present-day express service often proves too slow.

Aeronautical people all feel confident that with the lessons learned from military experience and with new safeguards thrown around the airplane in its operation and maintenance, such a service can be safely embarked on with our present-day knowledge and material. This must be proved by actual performance rather than by statement, and so the airplane builders or those with the necessary knowledge, enthusiasm and capital who will come forth as commercial operators, must take the risk. In one way or another they must actually carry passengers. They must carry them on schedule, comfortably and without mishap, and for a reasonable period of time. Experimental human material is needed, then, in addition to the experimental carriers of it. Mr. Douglas believes that there is plenty of such material in the adventurous, the curious and those whose extremity may be so great as to warrant the chance they are sure to believe they are taking at the time.

Passenger-carrying aviation falls into three classes of service, namely (1) scheduled regular service; (2) special taxi service; (3) tourist service. Of the three the first seems to hold the most promise of giving us our first real data on costs, maintenance and traffic. While it appears offhand to involve the risking of more capital than the last two, it need not preponderate greatly in this respect and certainly will offer a more accurate count of the public pulse than the other methods. By scheduled service is meant the operation of one or more machines flying between two or more points on a time schedule properly based on the safe speed of the plane, the altitude flown and the head winds likely to be encountered. *No such service has as yet been actually started either here or abroad.*

In England various airplane firms have ready machines carrying from 10 to 40 passengers; the French Farman carrying 12 persons and the big Caudron machines are only waiting for military questions to be settled before opening up regular service between London and Paris and other European cities. England has big projects along these lines throughout her colonial possessions and seems imbued with the determination to realize them. In Italy, Caproni is building larger passenger planes than anyone, which it is said will be operated from the northern to the southern part of that country and even across the Mediterranean to the African possessions.

But practically all of the American efforts in commercial aviation thus far have been along the lines of the taxi system. That is to say, at various leading resorts there are machines available for the public desirous of taking short jumps more for the sensation than for the actual covering of a given distance. In Washington several machines and some of the best pilots in the service are ready at any time to carry high officers or officials on a joy ride or a quick official trip to other cities within a radius of 400 miles.

Adventurous youth all over the land have gone into the aerial taxi business. Buying anywhere from one to a dozen planes, and renting or purchasing a suitable piece of ground to serve as an airdrome, they soon have a thriving business. Persons come in droves on Sundays and holidays to enjoy an air ride of from ten minutes to an hour, and gladly pay the fee of from $15 to $100. But all this is not benefiting commercial aviation, although it is fast eliminating that fear with which the general public viewed flying in the no distant past. Still, the scheduled regular service is the only form of commercial flying that can readily bring peace-time prosperity to our aviation industry.

As for other forms of commercial aviation, so much has been said and written that it is pretty much of an old story. Airplanes have made out fairly well as mail carriers on relatively short runs; but in covering routes of 500 miles and upward, they have fallen down on their schedules. In fact, the Chicago-New York route was unsuccessful in the first trials, but this was due mainly to faulty machines for this long haul, ignorance on the part of the pilots of the country traversed and a rather hasty start without proper organization and equipment. Next spring this run will again be instituted, and judging from the preparations being made and the machines that will then be available it should be as successful as the New York-Washington run.

(*Continued on page 232*)

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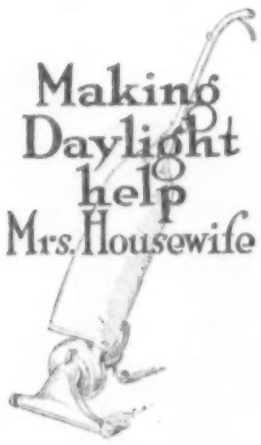
R. J. Reynolds Tobacco Co., Winston-Salem, N. C.



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Owners of the world's largest Asbestos Mines

What About Our Commercial Aviation?

(*Continued from page 230*)

Then there is the cargo-carrying service. Here the airplane is at a serious disadvantage, because cargo-carrying service by the usual methods of transportation is so very low in cost as compared with passenger-carrying. Still, it may be—and there have been instances of it already—that a certain business will spring up for the rapid transportation of perishable goods, replacement parts for damaged machinery, medical and surgical materials, motion-picture films, newspapers and luxury articles. Where speed is the very quintessence of transportation, the airplane will have a very definite field—and a profitable one, since the rates will be gladly met by those looking for such service.

Just a word about costs: Assuming larger and faster land machines working to the limit of their capacity, it may be shown that passengers can be carried with a good profit at as low as 10 cents per passenger-mile.

Gaging Screw Threads with a Beam of Light

(*Continued from page 215*)

projected on the chart at the other end of the apparatus. The space between the dotted lines represents the range variation in size that will be tolerated for a certain grade of work. Hence the screw thread shadows must come between these boundaries. The same space or zone is also the boundary for lead errors. A glance at the shadow reveals to the operator exact conditions—a perfect "diagnosis"—so that he knows just what kind of a fit will result from its use.

The inventor says that this system of gaging would eventually reject all lead errors in screws of minimum diameter, whereas the present system of gaging generally permits a greater lead error in the smaller screw than is tolerated in the larger. He says that it will be possible to use this machine taking the full license of the present gaging system, but this step should not be permitted on account of its making the most undependable screw.

The shadowgraph of the average screw proves that it is, as a rule, of uneven profile and a ragged surface. When these elements are recognized, then an acceptable product must be determined upon. Once the character of the work has been determined, a chart with boundaries that fit the gaging requirements, is used.

Mansions of Mud

(*Continued from page 218*)

strength of 400 pounds to the square inch. This enables him to dispense with the extremely thick walls of other days.

Whereas the old Dons were satisfied to plaster their walls with mud and protect this with a coating of whitewash in which had been incorporated tallow and cactus juice while the lime slaked, the 1920 builder covers them with hard cement plaster to thoroughly anchor into the walls—generally three coats—and waterproof throughout with an all-mineral compound evolved by himself and conceded by chemists to be virtually everlasting. Doubtless there are other waterproofing processes which might answer. The whitewash of the pioneers was a fair waterproofing but temporary. It had to be applied every year or two. When moisture penetrated to the mud plastering it came off. The adobe blocks, exposed to the elements, particularly rain, soon disintegrated as a rule, although some in the missions have defied the weather for decades.

The builder makes these claims for the houses now under construction: That they are everlasting, meaning that the occupants never will know the annoyance nor expense of the usual repair bills. That they are soundproof, so that howling winds, rattling roofs or other noises will not be heard within. That they are non-conductive and fireproof, cool in summer and warm in winter, and the owners can watch anything in conflagration nearby without an iota of fear for the loss of their dwellings. That they cost no more than wood—possibly even less—yet look and are as substantial as those of concrete or burned brick.

Adobe as used at Walnut Park and here illustrated appears suited for the expression of a peculiar style of better-looking domestic architecture. These houses are Spanish Renaissance and Moorish, harmonious, pleasing. This material must be used simply, without the eye-offending gewgaws and gingerbread encrustation that makes the pretentious modern bungalow more or less a nightmare to persons of taste; and therein lies its charm. Of the 200 homes each will have a distinct individuality. This undertaking holds out the prospect of a new era of building for both economy and beauty in America.

There are houses at Walnut Park with as many as a dozen rooms, built about spacious patios, and the units including garages within the surrounding walls. The cost is from a few to many thousand dollars each, and at least one soon is to be occupied by a millionaire. As in other kinds of construction, almost any amount may be expended. There is special opportunity for characterful and artistic interiors—arches, nooks, windowseats, massive mantels, and a general soft, romantic atmosphere. Externally the buildings lend themselves admirably to fascinating landscape departures—the better as the utmost simplicity is conserved.

Among the most interesting of the residences under way is an adobe-and-frame combination of a novel order. This is a ten-room house of English style, set somewhat apart from the others, and the first of its kind ever built so far as can be ascertained. The lower story is adobe and the second story and roof, now being finished, boards and shingles. This is rather more an experiment than the all-adobe structures but there is no reason why it should not be as complete a success. Its appearance will be no different from that of a house of frame and concrete or plaster but it would be much more comfortable if the claims made for adobe hold good. Aside from this house all the adobe structures in Walnut Park have tile roofs.

Battling with Snow and Ice in the Streets of New York

(*Continued from page 219*)

duce enough heat to do the job. There is no lack of temperature—that of course is simple; there is simply not enough heat. A fair sample of what happens to a proposition of this sort is seen in the fate of the flame-throwers, a legacy of the war, which were rushed to the metropolis under the impression that they would eat up the snow. They did—to the extent of eating a neat round hole through the snow, a few inches in diameter, at the point where they were directed. Even a second attempt to solve the problem along these lines went for naught. A device somewhat similar to the asphalt burner, and claimed to have been successfully used on the Canadian Pacific Railroad, was turned against the drifts. Again the effect was only a local one; and it was clear that to make any real impression there would have to be an absurd number of instruments, and an utterly impossible volume of fuel.

Melting the snow *in situ* being abandoned as a bad job, it becomes necessary to consider improved mechanical ways of removing it. One of our illustrations shows a machine modelled after the steam shovel. This did good work where the snow was sufficiently deep to give it something to bite into; but this was not always the case. Over a very considerable proportion of the city's streets there was merely a foot or so of soft, slushy muck or crusted snow or traffic-packed ice or

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a combination of these; the regular drift that could be attacked on the steam-shovel plan was rather the rarity.

A better performance was given by the apparatus illustrated on our cover and at the lower left of this page. This machine runs along, tracking on the ground already cleared and so free from danger of stalling. The shovels at the front collect the snow, which is carried up the chute and deposited in the box-like receptacle at the rear. This holds ten cubic yards—a good truck-load. When it is full, a truck draws up and at the throw of a lever receives the snow for hauling to the dump. Or if this is not convenient, the machine will discharge the snow at the side, just like the ordinary plow save for the manner in which the trick is done. It is claimed for this machine that unless its progress is retarded by an extraordinary accumulation of solidly frozen material, it can proceed through a snow-covered street at from two to ten miles per hour and deliver the snow at the rate of 10 cubic yards per 30 seconds, and that it can do this with any fall of snow up to five feet.

This machine was given a very successful trial, but it was not obtainable in sufficient numbers to make any real impression on the snow. In fact, the instrument which did the most to free New York, at least partly, from the bonds of the weather was one in whose favor little could be said except that it was to be had in any quantity necessary to enable it to do the job. This was a stream of water from the ordinary fire hose. Turned on a drift, a shoveler's pile, or the high ridge of snow thrown from the side-walk and left standing between the gutter and the single-track roadway broken through the middle of the street by the traffic, it demolishes the frozen mass in short order and washes it away down the grade. The melting effect obtained through this very broad contact of the snow and ice with water which is itself but little above the freezing point, is far greater than got through the very limited application of intense heat. By the time the swiftly flowing mass reaches the sewer opening at the end of the block, it is in shape to enter and continue on its way to the outlet at the river front, without clogging the sewer as would be the case if large chunks of ice were dumped promiscuously into the manholes. Most of the down-town streets were finally freed this way—and in connection with the process there was one glorious retribution. As the surging tide rushed toward the sewer, the store-keeper who had cleaned his gutter out properly in the first place could watch it with no thought save for the emancipation of traffic in prospect; but the tenants who had slacked in the cutting of the gutters, or who had ignored this business entirely, could be found knee-deep on their sidewalks, armed with brooms and shovels and ice-cutters, in a desperate attempt to provide a channel for the water and save their cellars from flooding.

Again the Steam Automobile

(*Continued from page 220*)

pletely surrounded by pipe coils. In an atomized fire, it is necessary to have a long space for the proper burning of the fuel; but great difficulty has always been experienced in the breaking down of the refractory linings under this sort of a fire. Again, it is necessary to complete combustion before the fire touches the boiler tubes, or sooting will occur. With the combustion chamber as shown in the drawing herewith, the fire cannot play on any coil, and the heat is gradually absorbed over a large area; so no trouble is experienced in burning boiler coils or breaking down the refractory lining.

Much trouble has always been encountered in this sort of a propulsive system with the automatic control of temperature and pressure. Numerous by-pass valves, all of which were delicate, unre-

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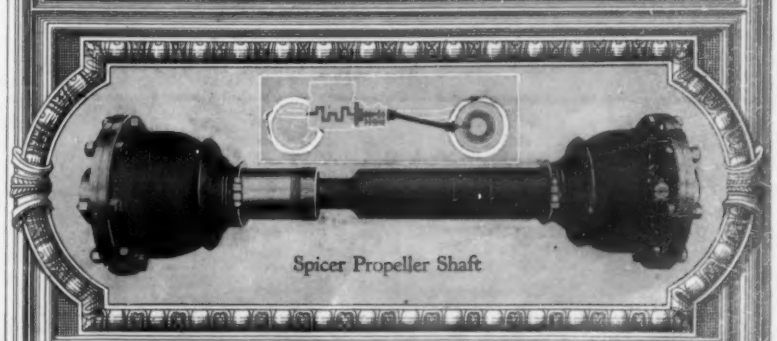

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liable and sluggish in their action, have been employed in this service. The present control system consists of a steam gage which operates an electric switch controlling a motor. As the water and fuel pumps are driven by this motor, they are pumped in a definite quantitative relation to the needs of the engine. The length of time that the motor is on depends upon the demand for steam; under different conditions, the motor will be on anywhere from a third to all of the time.

This has the advantage of locating all parts containing water right at the boiler. Also, it is no longer necessary to use a cushion in the water line to prevent hammer. These cushions were usually spring-loaded pistons, which constantly broke their springs and required repacking. The safety valve is likewise eliminated in favor of a fuse in the motor circuit.

In starting and stopping the motor, the steam gage operates a small switch which is set to open at 600 pounds pressure and then to close again when the pressure has fallen to 500 pounds. This differential action between the opening and closing pressures is an absolute necessity, and is brought about by a small magnet on the back of the steam gage, acting with a pin on the Bourdon tube of the gage.

In similar fashion the kerosene gage controls the action of the spark-plug circuit, which is closed from zero to 25 pounds pressure and open above that figure. When the motor is running, the normal pressure on the delivery side of the fuel pump is 35 pounds, so the upper limit of 25 pounds provides for a sufficiently early cutting off of the spark.

In addition to the pressure cut-off, a steam-temperature gage is used in connection with a second cut-out circuit. The normal temperature of the steam in operation runs from 600 to 750 degrees Fahrenheit. The gage is set to cut off the fuel feed at 800 degrees. This switch seldom comes into action in the normal working of the system, but affords a safety means to shut off the fire in the event that the water tank goes dry. It also acts as an automatic corrector of the fuel-water ratio, if this should by any means become upset.

Like the average gas car, this system uses an electric motor, a storage battery and a dynamo. The dynamo furnishes all of the current to the motor direct when the latter is running. When it shuts off, due to steam pressure above 600 pounds, the series field of the dynamo is automatically cut out, reducing the dynamo output to a current suitable for charging the battery. Where the speed of the engine is nearly constant it is possible to eliminate the dynamo, motor and battery; but it is then necessary to have hand starting devices, and a dry battery for ignition and for control of the small magnets that act on the suction valves of the pumps. The inventors feel that the motor and storage battery is the most direct and simple means of attending to all this.

A source of trouble on previous steam automotive systems has been in the water pumps. These were noisy; their valves were short-lived; they would get air-bound when the water in the tank was too hot; they required constant adjustment of stuffing boxes. The attack upon the first of these problems has been made by designing the valves so that they have small lift, and by the fact that regardless of the car speed, the pump runs always at the same speed. On the second count the inventors have tried to score by using the best of rust-proof metal for the valves. Air-binding is prevented by the practical absence of clearance space. Finally, no stuffing box is used at all; the entire pump is enclosed in a case and submerged in oil. Then the plunger is so designed that there is no side thrust on it, the alinement being perfect at all stages of the stroke. With the pump cylinder long and the bore absolutely round and straight, the stuffing box can be omitted and there is still a minimum of friction between plunger and cylinder.

The engine is of the semi-uniflow type, two-cylinder, double-acting, poppet-valve. The valves never need to be reground. Special care has been taken to have the metal in the cylinders uniform in section, so that even when hot expansion is even.

To avoid heating of the oil in the cam box, the latter, which carries the cam and tappets for operating the valves, is insulated from the cylinders. Different points of cut-off and reverse are obtained by shifting the cam, which is of a special shape permitting this *ad lib*. Low steam consumption is secured by short cut-off, tight valves, small clearance space, free exhaust, and the uniform section of the cylinder metal. Perfect alinement is again substituted for stuffing boxes on valve stems and piston rods. For pleasure-car use the inventors propose to mount the engine partly on the rear axle but mostly on the frame. For truck work they would mount the engine on the frame of the car, using a standard road axle. In the pleasure car, of course, drive shaft and universal joints are eliminated by the location of the engine with reference to the driving axle.

Melting Brass Electrically

(*Continued from page 221*)

would require skillful manipulation could not be expected to withstand the rough service to which it would be put in foundry work. The rocking electric furnace has been reduced to very simple form capable of being applied to commercial practice.

It has been found that the speed of production depends entirely upon the rate at which heat can be generated within the furnace safely; that is, without injury to the refractories or to the metal under treatment. The speed of production also depends somewhat upon the efficiency with which this heat is transferred to the brass. During the researches of Dr. Gilleft, it was found that the refractories used in the furnace chamber should not be exposed to a temperature very much above the pouring temperature of the metal. If this were done a minimum maintenance cost would result.

Rapid melting requires a great temperature difference between the source of heat and the metal. Therefore, it is desirable to place the heat source in the furnace as close to the metal as practical. There should be no obstacle in the form of a refractory wall between the metal and the source of heat. If such a wall is interposed between the metal and source of heat it will offer a very high thermal resistance which greatly reduces the general efficiency of the furnace.

A good quality of metal depends largely upon the ease and certainty with which the pouring temperature can be reached. The avoidance of impurities and a perfect mixture of the alloy are also factors which enter into the quality of the metal.

The principal cost in melting copper alloys which contain considerable percentages of zinc and lead is the great loss of metal by volatilization and oxidation. It has been found quite impossible to eliminate this process entirely, but, on the other hand, these effects have been reduced to a minimum by melting the metal in a tightly closed furnace chamber and in the presence of a neutral or reducing atmosphere. The fuel-heated furnace must be fed with a constant draught, which not only oxidizes the metal, but also carries away valuable metallic vapors as quickly as they are produced. This is where the electrically-heated furnace has its great advantage over the conventional forms. The furnace chamber of the electrical device is entirely enclosed and the metallic vapors which are produced create a vapor pressure which tends to prevent further vaporization.

The rocking electric furnace hereto-

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fore mentioned consists primarily of a cylindrical steel shell properly lined with refractories and mounted upon ringed gears and rollers. The furnace is so mounted as to permit it to be rocked through an arc from a few degrees up to 200 degrees. The rocking motion is produced by an induction motor which transmits its power through a reducing gear, properly mounted and immersed in oil, to the gear case. The motor action is entirely automatic, being controlled by a reversing switch which can be set to give the desired angle of motion.

The source of heat in the rocking furnace is an electric arc. This is drawn between two graphite electrodes mounted axially in the furnace and meeting at the center. Hand wheels control the electrodes and permit them to be regulated or entirely withdrawn from the furnace. While the furnace is being filled it is possible to withdraw the electrodes to a point where their ends will just clear the interior wall of the furnace. When occupying this position the furnace can be filled without fear of breaking the electrodes.

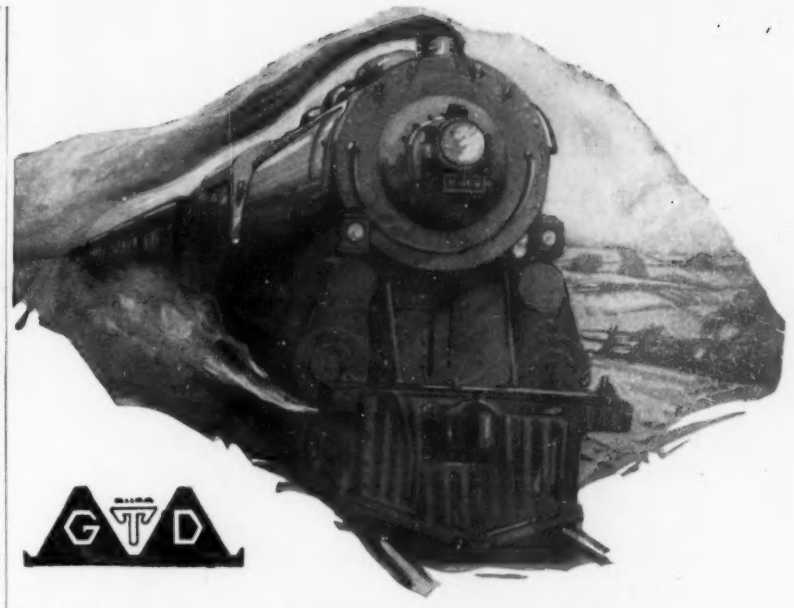
When the furnace is filled the electrodes are brought into operating position and the arc is started. The furnace is permitted to remain stationary during the first few minutes of the operation. If it were rocked immediately, before the metal had an opportunity to soften, it would be sure to cause electrode breakage. As the metal softens the rocking motion of the furnace is started, first through a small angle, and this is gradually increased until the maximum motion is obtained when the metal enters the superheating stage. As the furnace rocks to and fro the molten metal washes the inner linings to within a few inches of the charging door, at each oscillation which takes place every half minute. This washing of the chamber with the molten metal is extremely advantageous and adds greatly to the efficiency of the furnace. As the molten metal washes over the refractory walls all the superfluous heat which these walls may possess is given up to the metal and thereby put to useful work before it has a chance to penetrate the walls and escape into the atmosphere by radiation.

When the metal is melted and the furnace is stationary, the metal is from 7 to 10 ins. from the arc. Due to the constant motion of the furnace the direct radiation from the arc produces and maintains a constant temperature throughout the whole mass and prevents the surface from heating which would result if the furnace was allowed to remain stationary.

After the metal under treatment has reached the pouring temperature the arc is broken and the metal allowed to run out through a spout which is placed beneath the charging door. If it is impossible to pour immediately it has reached the proper heat, it may be held in the furnace without danger of overheating as no part of the furnace is hotter than the metal.

Due to the indirect arc a uniform power input and a steady electric load are maintained. It has been found very easy for the operator to judge from the kilowatt hour input how to adjust the rocking of the furnace and the time when the metal is hot enough to pour. He knows just what condition his metal is in from his meter which tells the kilowatt hours of heat put into the furnace.

The power input of the furnace has been found to be relatively large and its thermal efficiency is very high. At an average the metal is 10 inches from the arc and the nearest refractory wall is 18 inches from the arc. The end walls are 20 inches from the arc. This arrangement makes possible a rapid heating without injury to the refractories. In using 2,000 lb. or short ton charges, the rocking furnace will produce 2,000 lbs.



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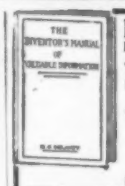

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of molten brass per hour. This capacity is much higher than that which is obtainable with an electric brass furnace of the non-rocking type.

Owing to the simple and rugged construction the reliability of the furnace is very high. Its cylindrical form makes possible a very strong refractory structure. The generation of heat is brought about without complicated parts and the operating gears of the rocking furnace are not exposed to high temperatures. The electric equipment is extremely simple and is seldom a source of trouble.

In furnaces which heat the metal through a refractory wall the metal will absorb heat after the current is turned off. This is not true with the rocking furnace. The heat input stops abruptly when the circuit is broken and it is possible to hold the metal within the furnace a considerable length of time without danger of overheating.

The thermal efficiency of the rocking type of electric furnace has been found very much higher than that produced by furnaces of the indirect or direct arc type. In fact the efficiency compares very favorably with that of the induction furnace in which the resistivity of the metal produces the heat. The high efficiency of the rocking furnace has been found largely due to the oscillatory motion of the furnace by means of which approximately 4/5 of the refractory lining is washed by molten metal. The refactories are subjected to a continuous cooling action and are therefore kept at a temperature very close to that of the metal.

The number of kilowatt hours required per ton of metal fluctuates greatly and depends upon the operating condition and the nature of the charge. A large rolling mill which operates its furnaces on a 16-hour day with 60-40 brass obtains a minimum consumption of 225 kilowatt hours per ton. This furnace has averaged 224 kilowatt hours over a total of several hundred heats. An 8 to 10-hour operation with clean scrap and new mixtures shows 250 kilowatt hours for yellow brass and 275 kilowatt hours for red alloys. With a very dirty charge which includes oily or wet borings the energy consumption may reach as high as 300 kilowatt-hours per ton.

The rocking furnace has been found able to handle dirty borings and scrap of practically any kind. It is also found possible to heat a charge consisting of dirty borings and grindings without opening the furnace after the process begins. This cannot be done with any other furnace without a high metal loss.

Better Light for Microscopy

(*Continued from page 223*)

lamp itself can be had in either colorless or daylight blue glass.

For low-power work the binocular microscope is a tremendous advantage for it enables one to take advantage of binocular vision and obtain a better impression of relative distance and of relief in the object under examination. To illuminate this object with the new lamp simply requires a spur which can be clamped to the stage of the microscope as shown in another figure; while a fourth illustrates a shutter which may be slipped under the lamp to cut off light from one-half the source should shadows prove desirable. It is often found that objects show more details when illuminated from one side.

The various objectives, even including the high-power oil-immersion objective as well as those of the single- and double-objective binoculars, can be illuminated by this new lamp. Photographs may be taken in from 10 to 40 seconds, the long exposure offering no difficulty since the illuminator will move with the microscope should vibrations be set up. Where deep hollow objects such as steel test-dishes used in the enamel industry are to be photographed the lamp is lowered with the objective into the dish and accurate results can be obtained. This is also important in the study of pond life in samples of water held in glass or porcelain dishes. It is claimed that not only can a greater wealth of detail be obtained with this illuminator than with older types but that eye-strain is much reduced if not indeed eliminated because of the soft character of the light under discussion. Obviously the interference rays encountered in vertical illuminators are absent. The accompanying illustrations have been made with this new illuminator and indicate that microscopy has been provided with a new eye which should aid materially in producing much as the result of new research in important fields of microscopy.

Firing Shell Into a Concrete Tank

(*Continued from page 224*)

with dummy fuses or plaquettes of shell mouth size; but that the larger plaquettes were unable to stand the force of the normal blow, and where they did not strip off they canted and upset the mouth of the shell.

In the course of these experiments it was developed that the continual firing of the shell into the water butt at high pressures had a tendency to open up cracks and seams and cause a leakage in the tank, which proved a very serious consideration, and which, in connection with the experiment where the shell was detonated in order to recover the fragments, seriously impaired the retaining walls of the tank. This action can be readily understood by one who has seen the test and observed the churning up of the water at each discharge of the gun. The fragments of the detonated shell were recovered quickly and were entirely free from dirt and other foreign material. It was found that it was inexpedient to try larger shells than 75 mm.

The proof officers who observed the testing tank very carefully were of the opinion that better conditions for shell test were met with when the shell are fired into sandy soil at somewhat near the maximum range. This gives excess pressures of shell in the gun, low velocities of shell at recovery field, and actual conditions of shell firing imposed on the shell for upset or breaking. On sandy soil the speed and per cent of recovery of shell fired compares quite favorably with that of the water butt firings, and while more men or laborers were required to recover the fragments in such a field, yet this is offset by the cost of filling the tank every so often. Accordingly it seemed to be the conclusion that an artificial tank of the size and type constructed was of questionable value; but, like other scientific experiments, negative results are often as important as positive, and with the unique equipment illustrated enough was accomplished to show the limitations as well as the possibilities of the method.

Electron Tube Generator

OWING to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit, when used as a generator, are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit behaves as a filter in series with the tube and the direct current power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents, depending in amplitude solely upon the fundamental constituents of the tube currents. In Scientific Paper No. 355 the Bureau of Standards tells how general expressions are derived for the power and current output in terms of static characteristics of the generating tube, and are corroborated by experimental results obtained with a particular tube.